

Cold Climate Air Source Heat Pumps

Results from Testing at the
Canadian Centre for Housing Technology

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Snapshot

- Dispelling the myth - New cold climate air source heat pumps (CC-ASHPs) do work in Canadian winters
- CC-ASHPs are important in areas where natural gas is not available
- Paybacks under 5 years vs. fuel oil or electric baseboard



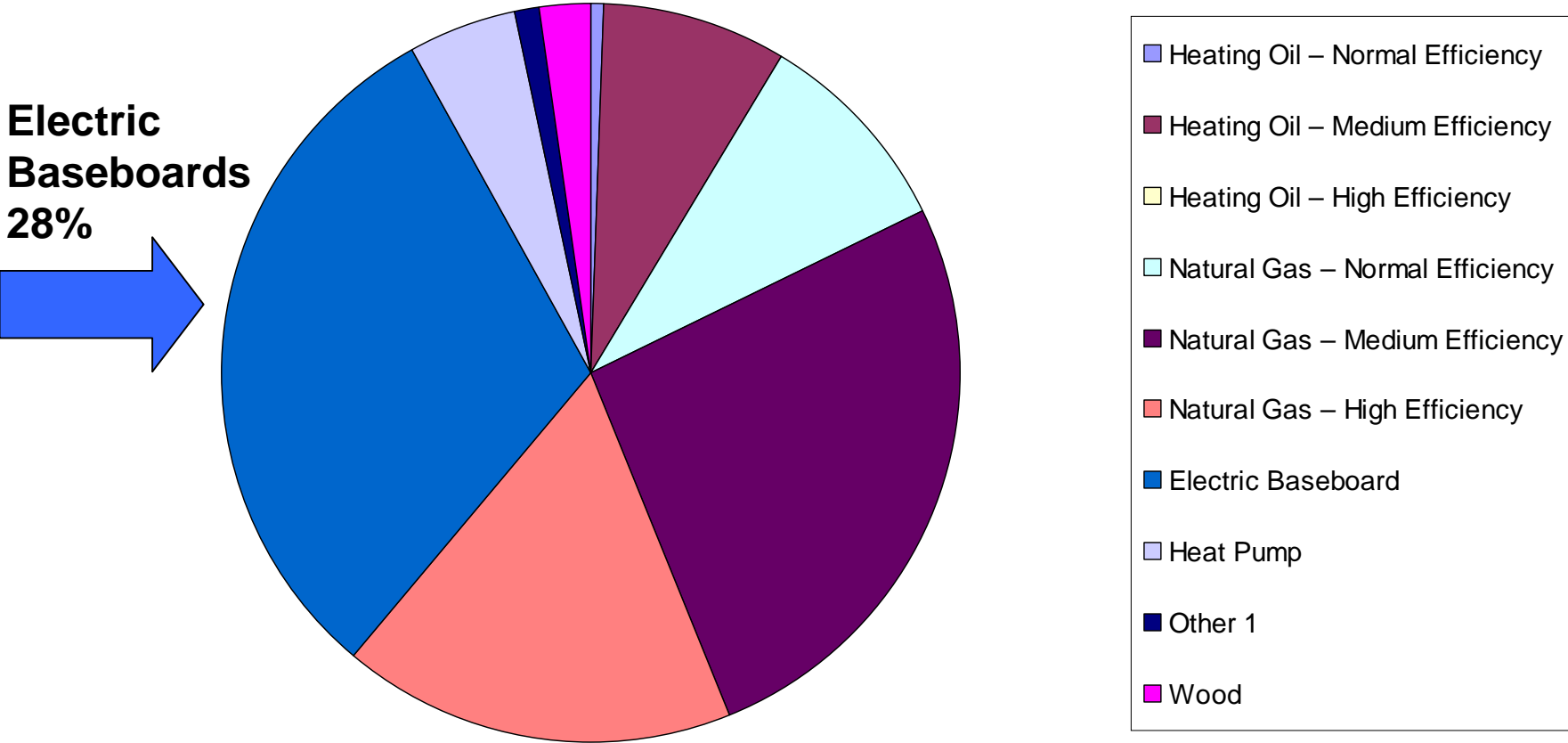
Presentation Outline

- Why CC-ASHPs
 - Millions of electric & fuel oil heated homes in Canada
 - Gaps in CSA equipment test standards
 - Well suited to low energy homes (including Energy Star, R2000, Net zero)
 - Cover loads beyond traditional air source heat pumps
- How we characterised performance
 - Testing at the Canadian Centre for Housing Technology
- Results
 - Ducted, Ductless CC-ASHPs
- Discussion

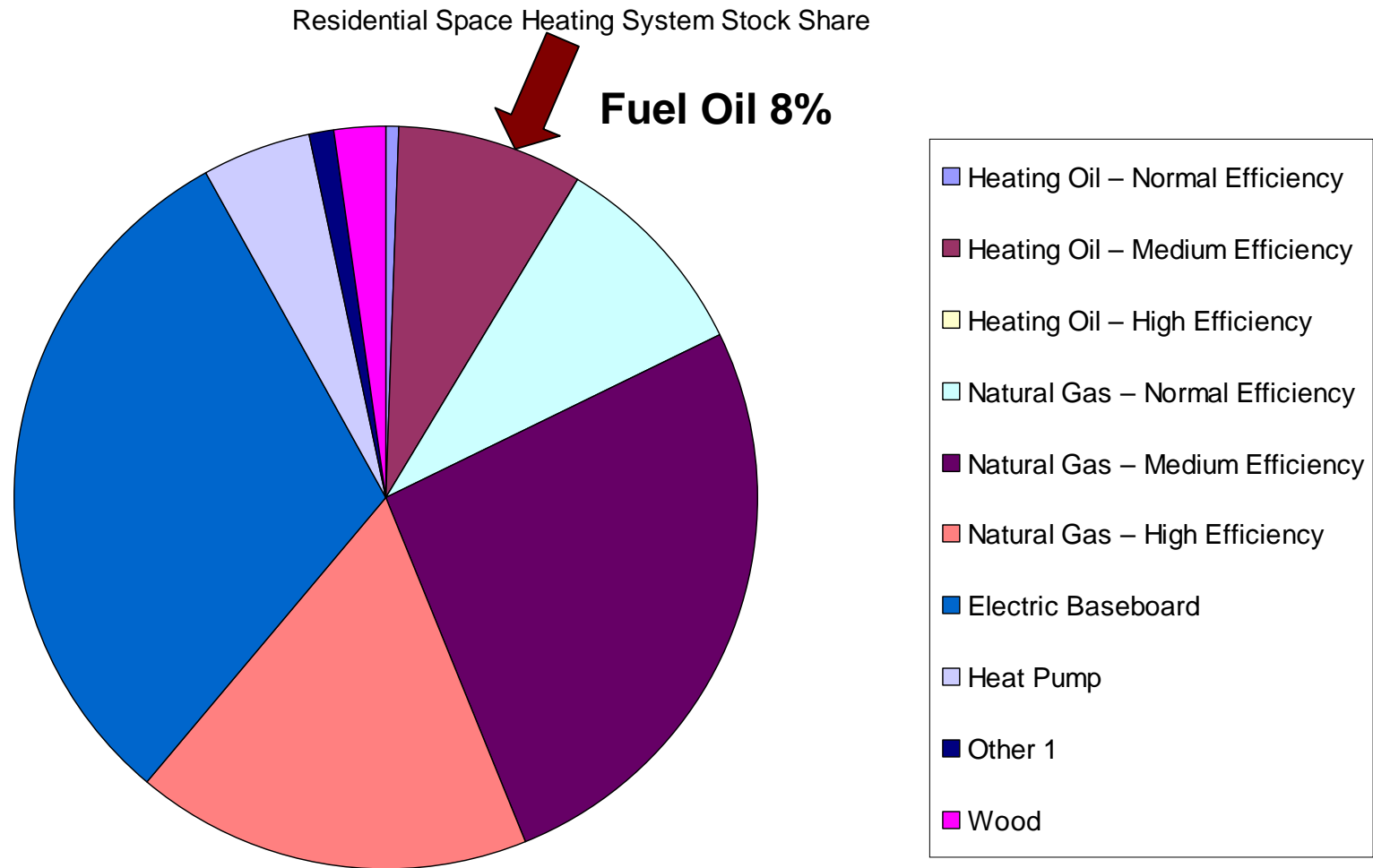


28% or about 3 million residences in Canada with electric baseboards

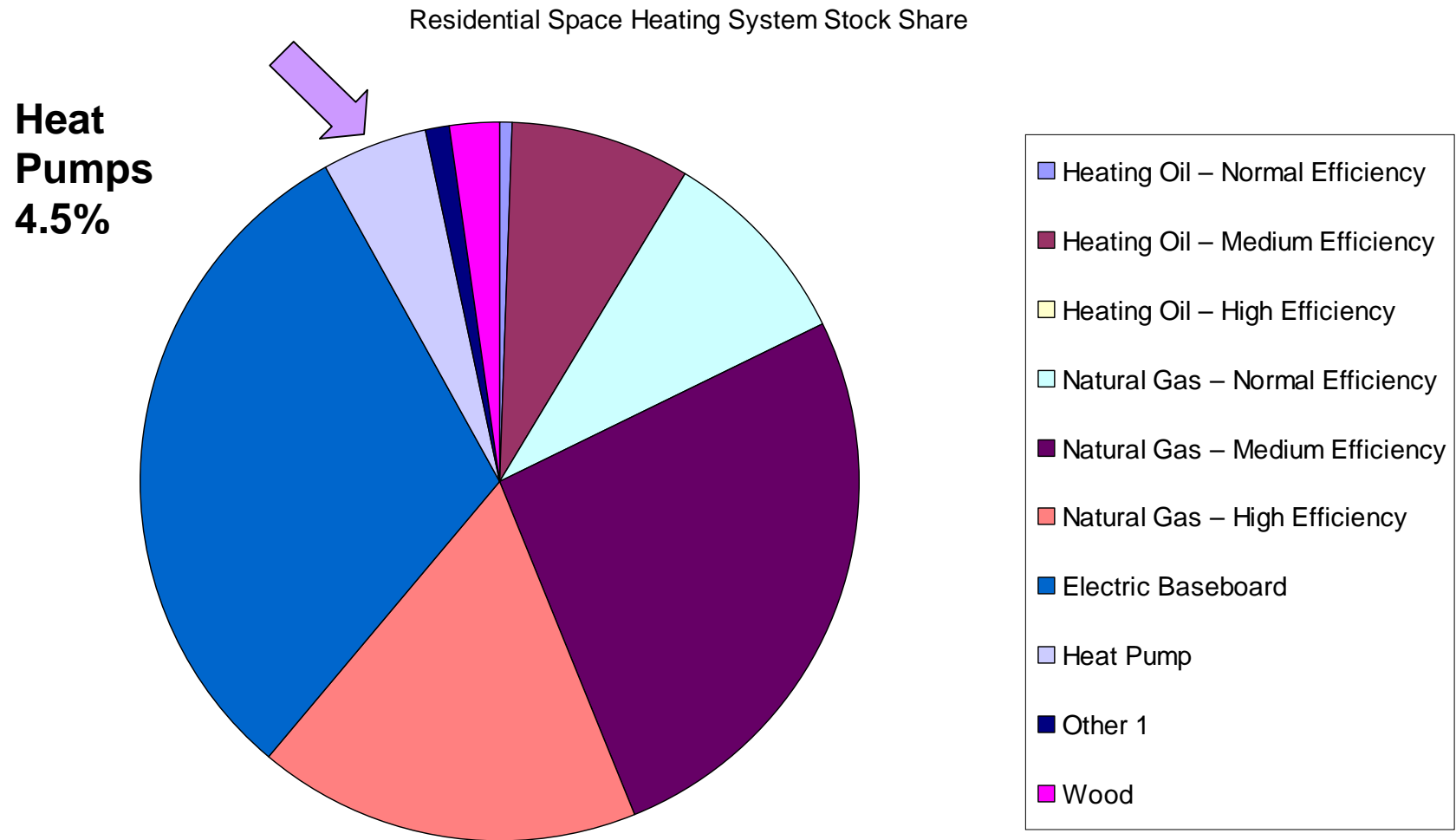
Residential Space Heating System Stock Share



8% or about 1 million residences in Canada with fuel oil



4.5% or about 300 thousand residences in Canada with heat pumps



Gaps in CSA Performance Ratings

- New air source heat pumps operate at much lower temperatures
- CSA Standards being updated to reference lower temperature performance ratings
 - COP (heating) and capacity at $-8.3\text{ }^{\circ}\text{C}$ will be the lowest rating point required
- **Most of Canada has design temperatures well below $-8.3\text{ }^{\circ}\text{C}$, so what is performance at these lower temperatures ?**

COP = Coefficient of Performance
(Output/Input)

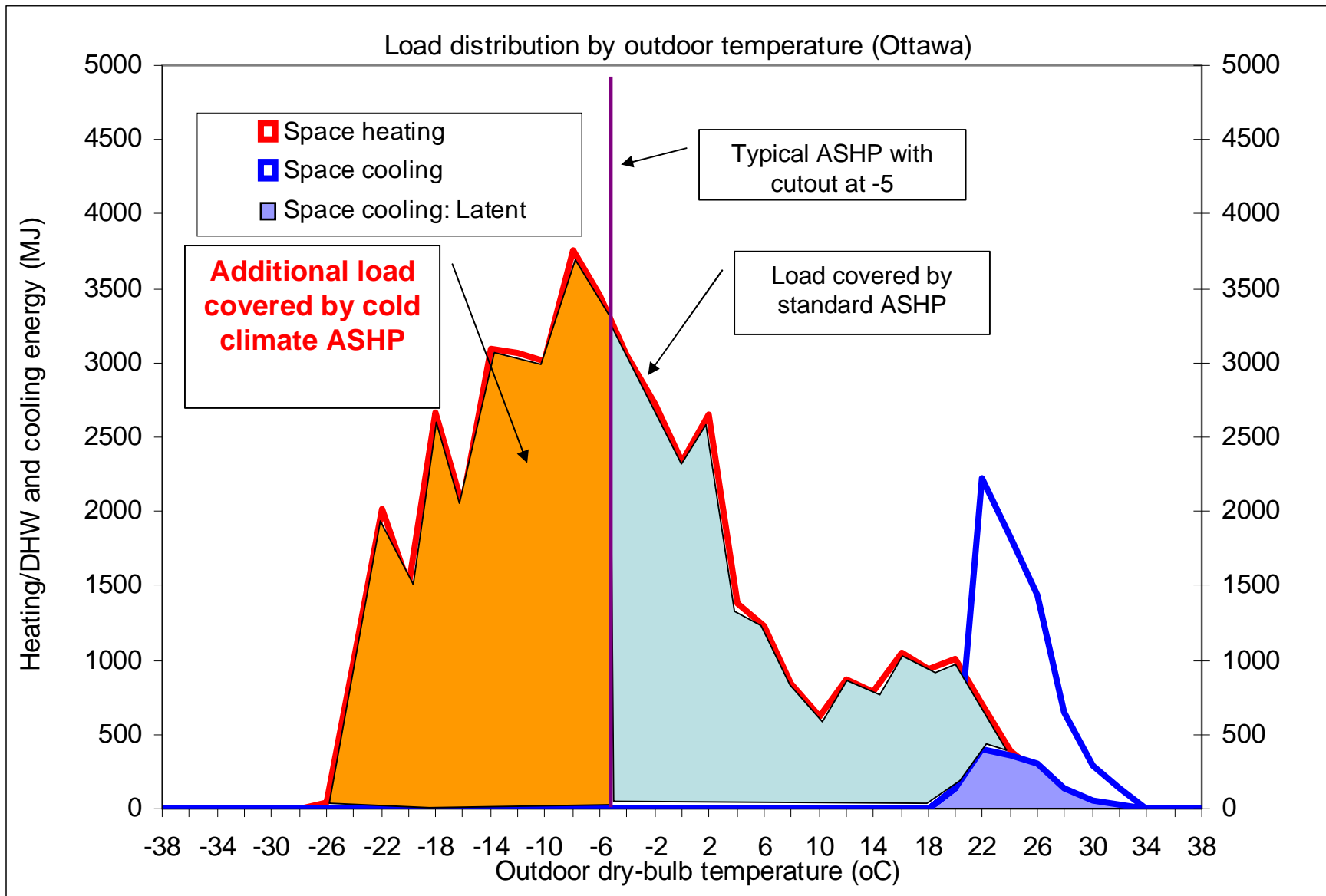


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CC-ASHPs cover loads beyond conventional ASHPs



How we characterised performance ?

- Performance testing and comparative analysis at the Canadian Centre for Housing Technology (CCHT) of:
 - Ducted cold climate air source heat pump
 - Ductless cold climate air source heat pump
 - Compared with standard natural gas condensing equipment

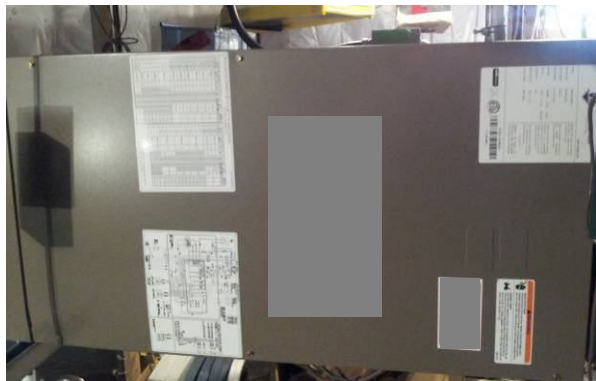


Systems Tested

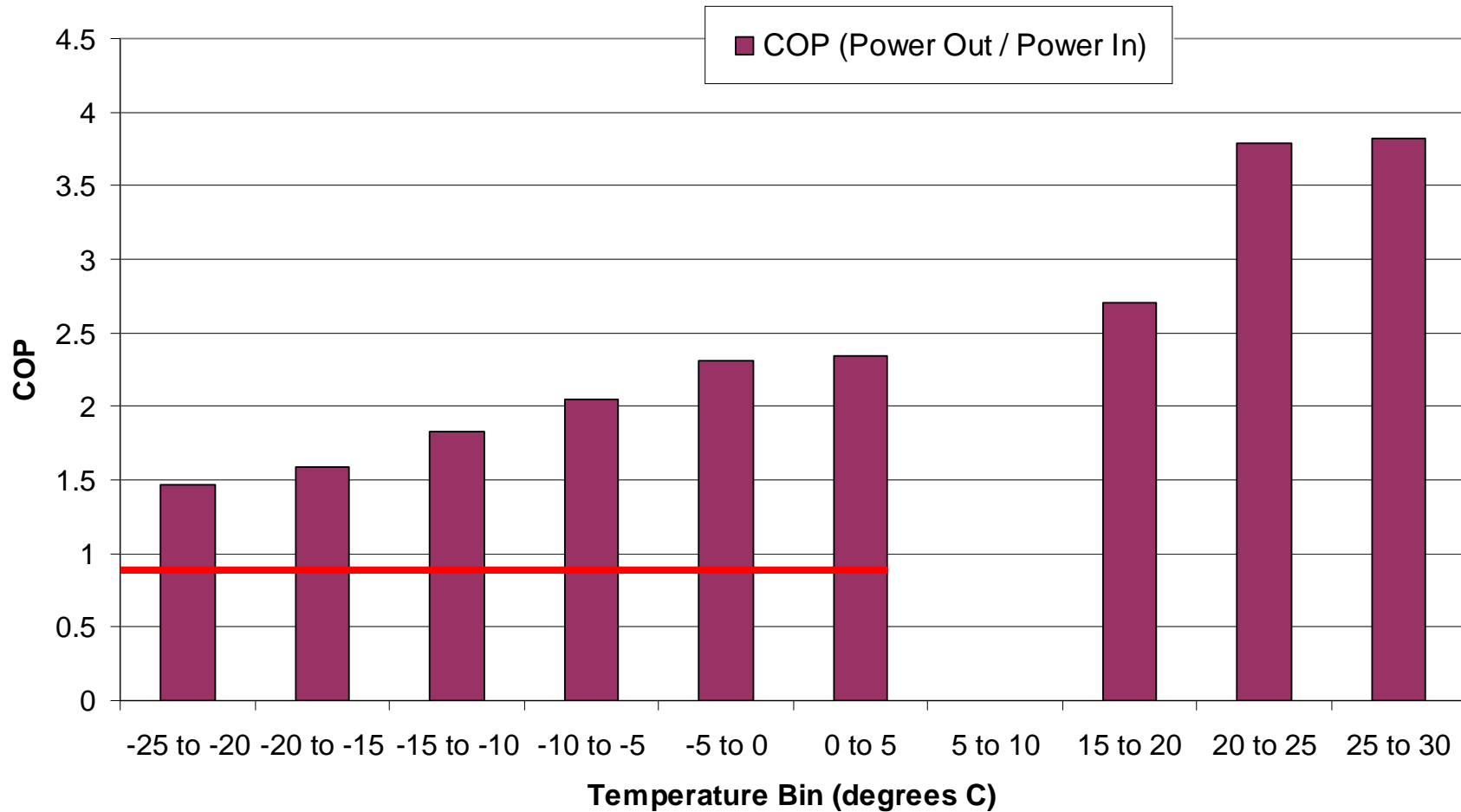
Ducted cold climate
air source heat
pump



Central A/C +
furnace



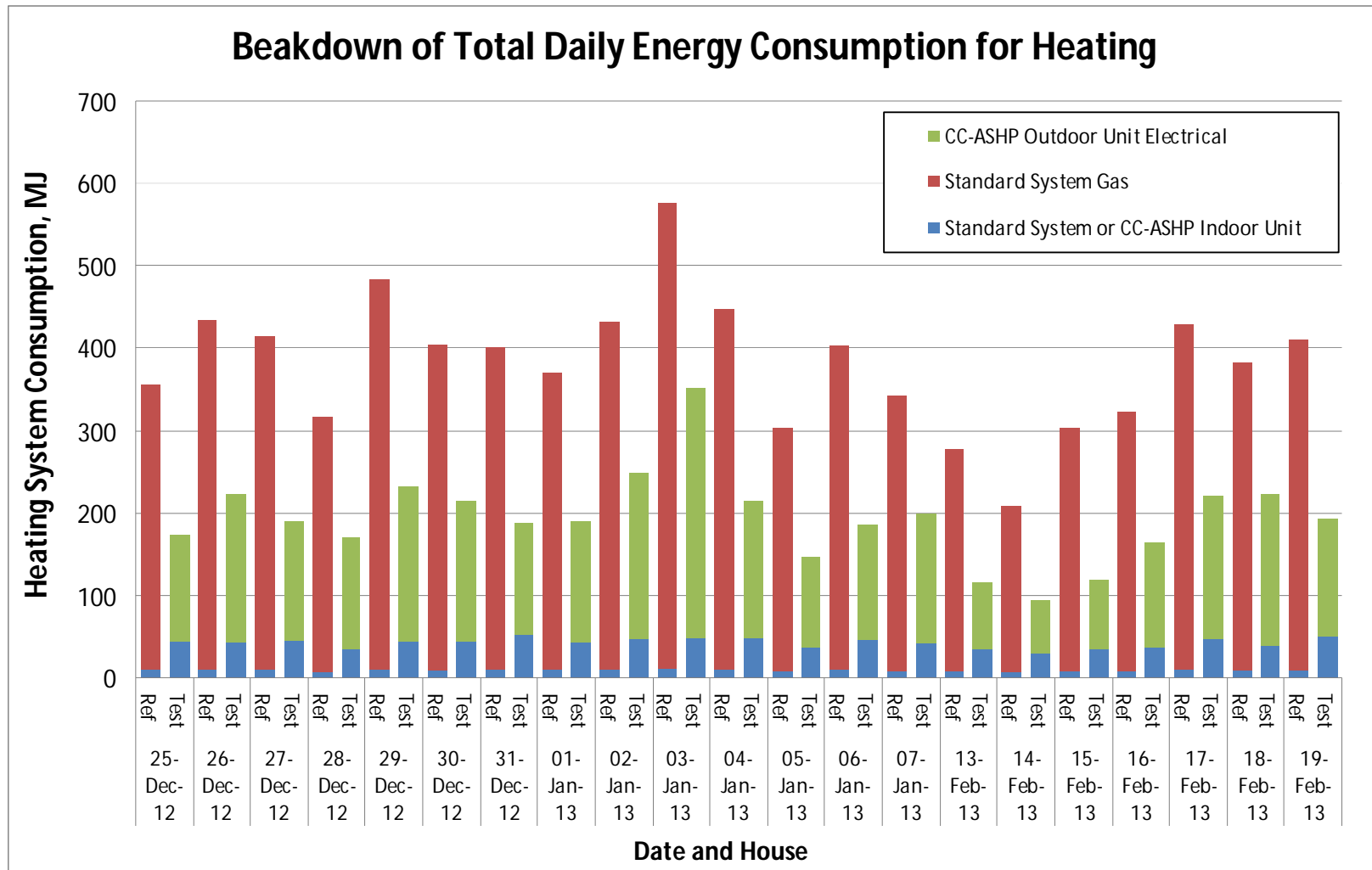
Centrally Ducted CC-ASHP - Annual Performance Testing Coefficient of Performance (COP)



- **COP from 1.5 to 2.4 in heating**
- **Gas has COP < 1**



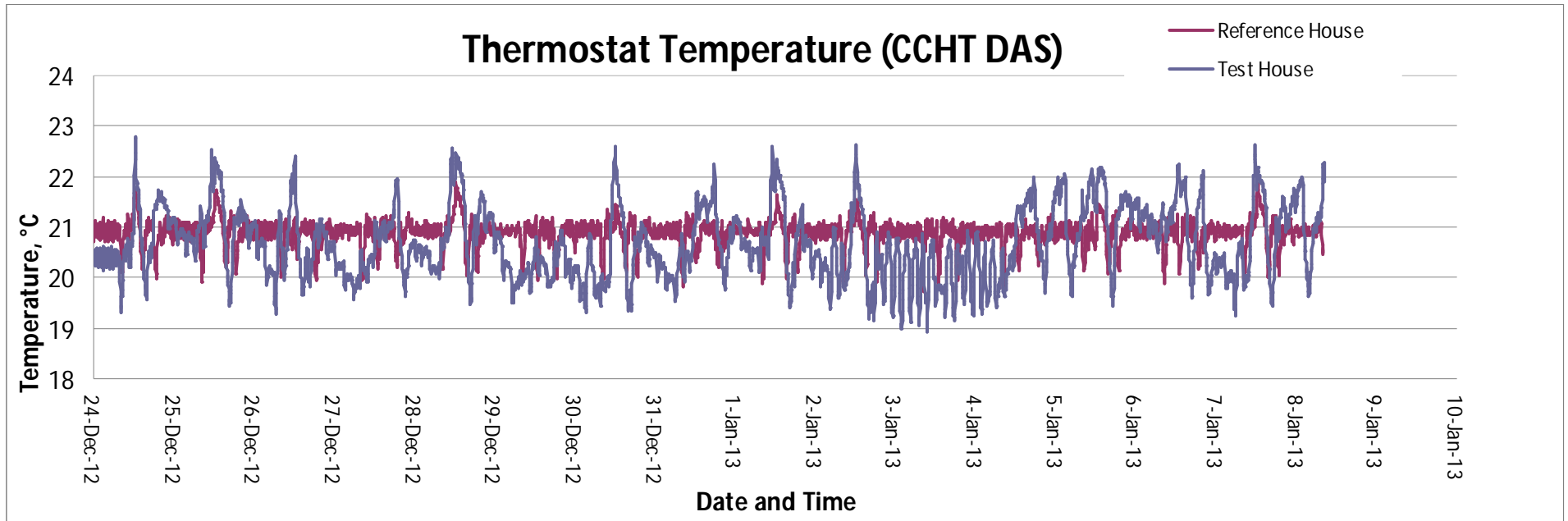
Performance Comparison with Gas



■ **49% energy savings**



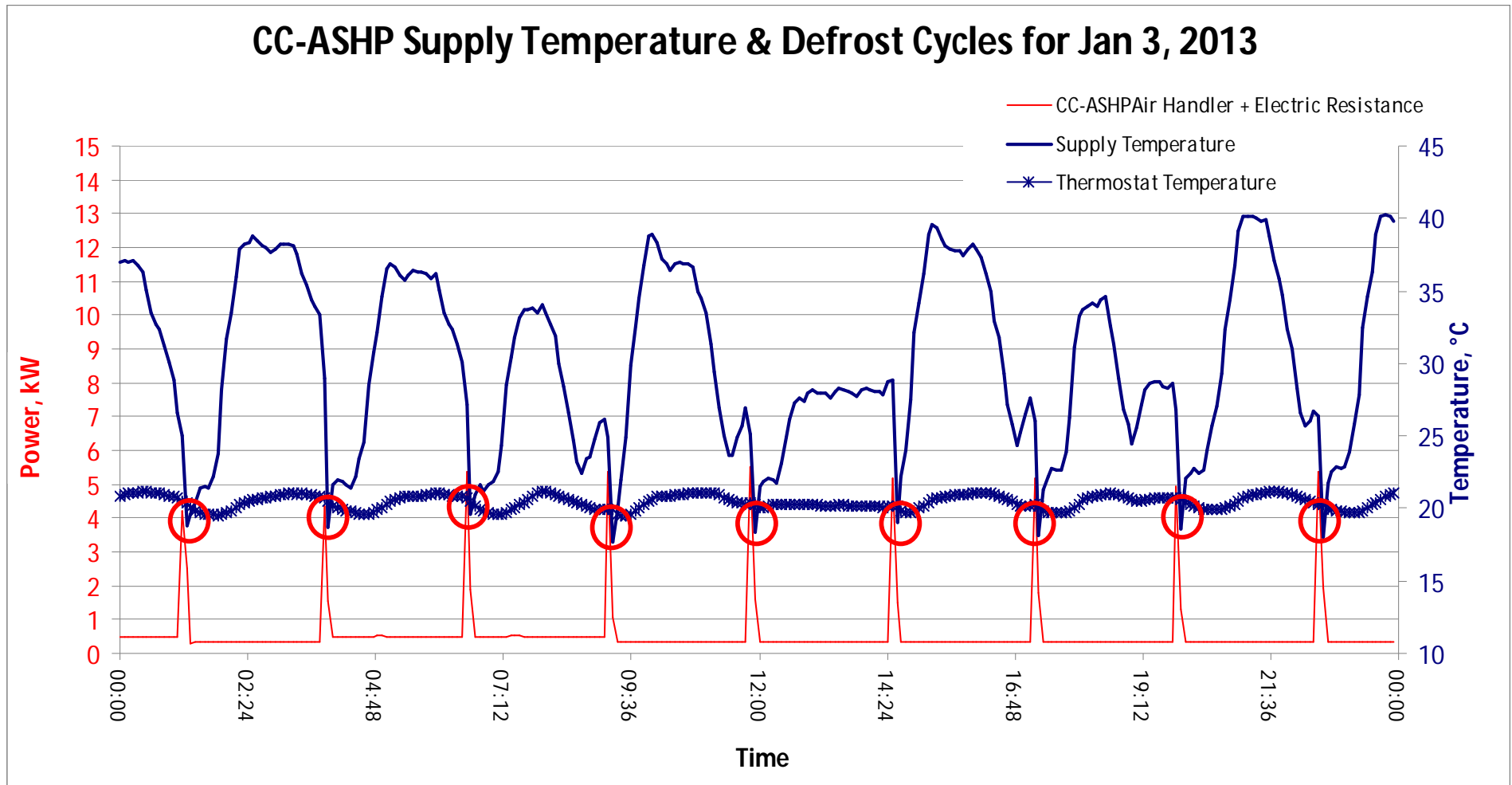
Comfort Comparison with Gas



- **Temp. swings: double that of a furnace, variable resistance coil control option could alleviate the issue**



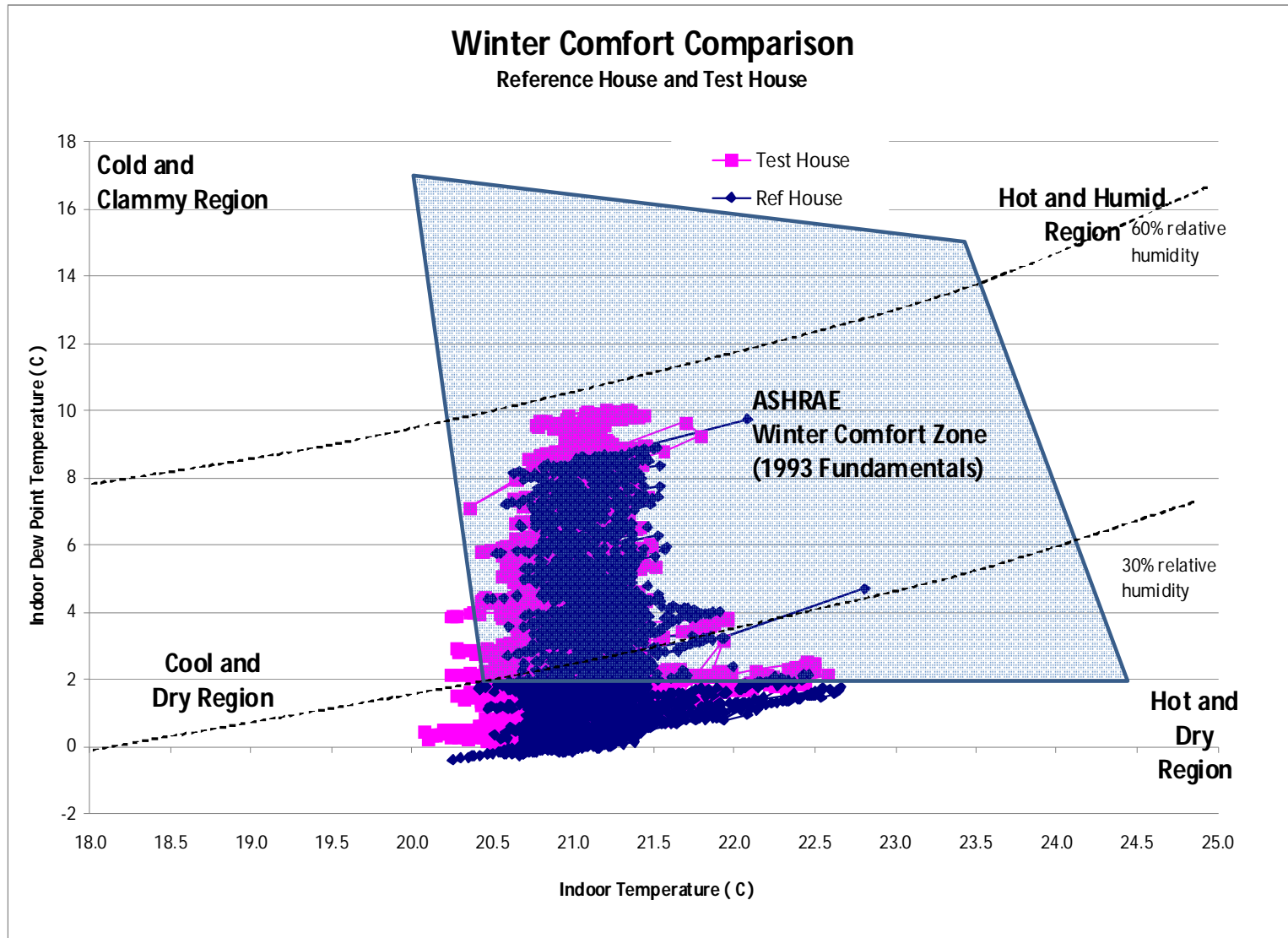
CC-ASHP Defrost Cycle



- **Electric Resistance: Tempers drop in supply air temperature during defrost cycles. Does not explicitly defrost.**



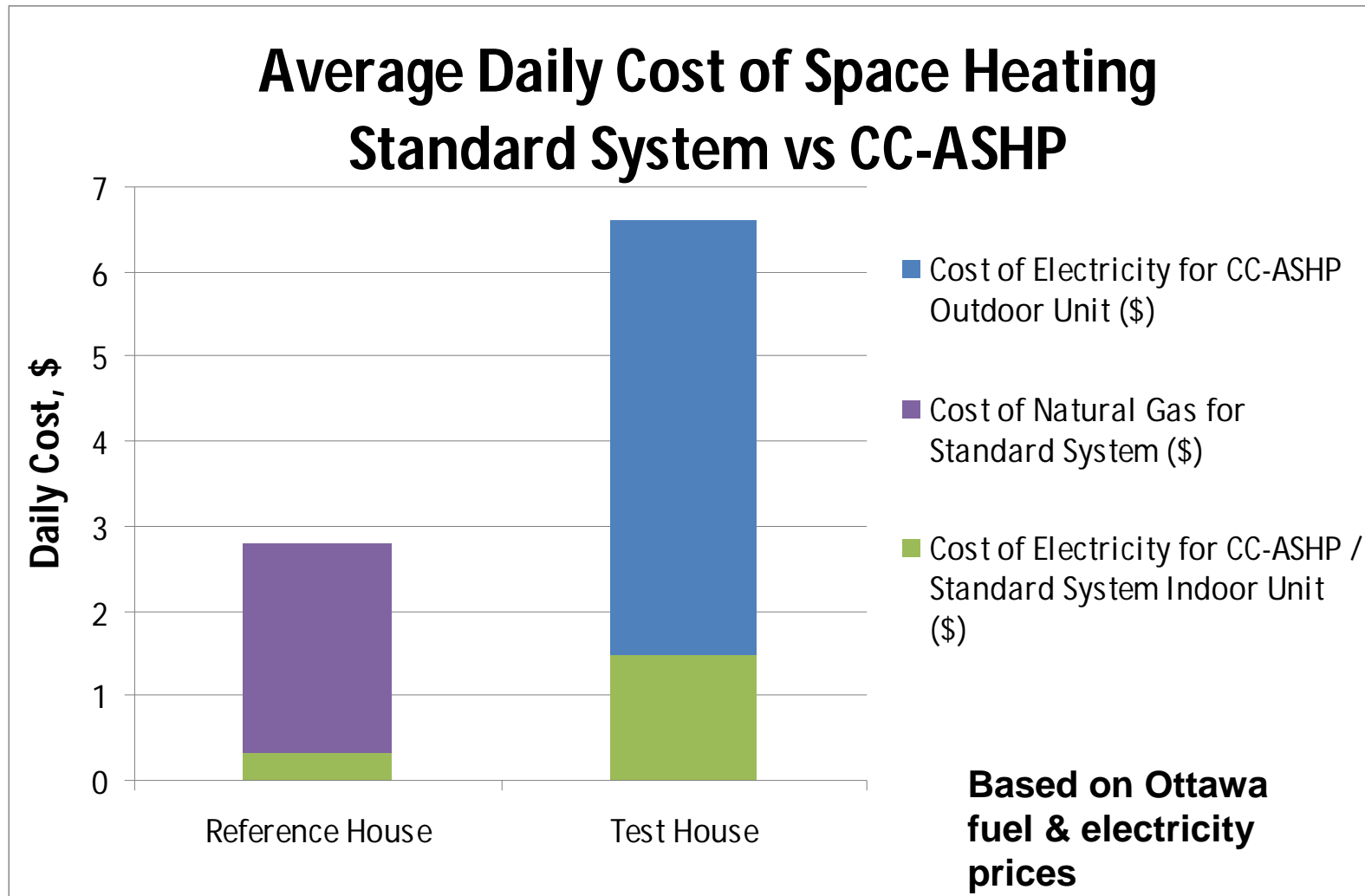
Comfort Comparison with Gas



- Both homes comfortable, slightly dry & cool (Canadian winters)



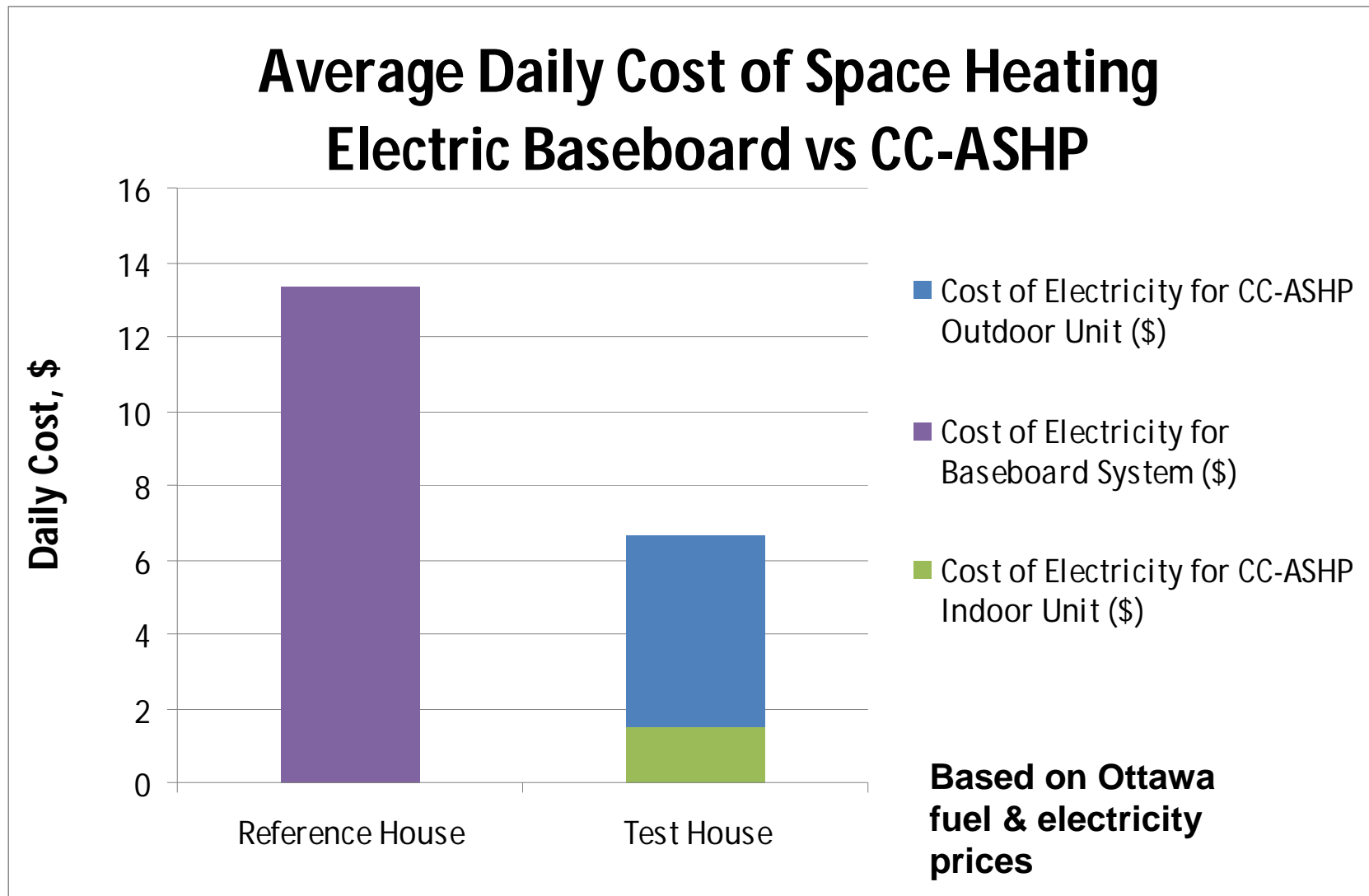
Operating Cost Comparison with Gas



- **Versus gas, CC-ASHP costs \$3.66 more per day, +124%**



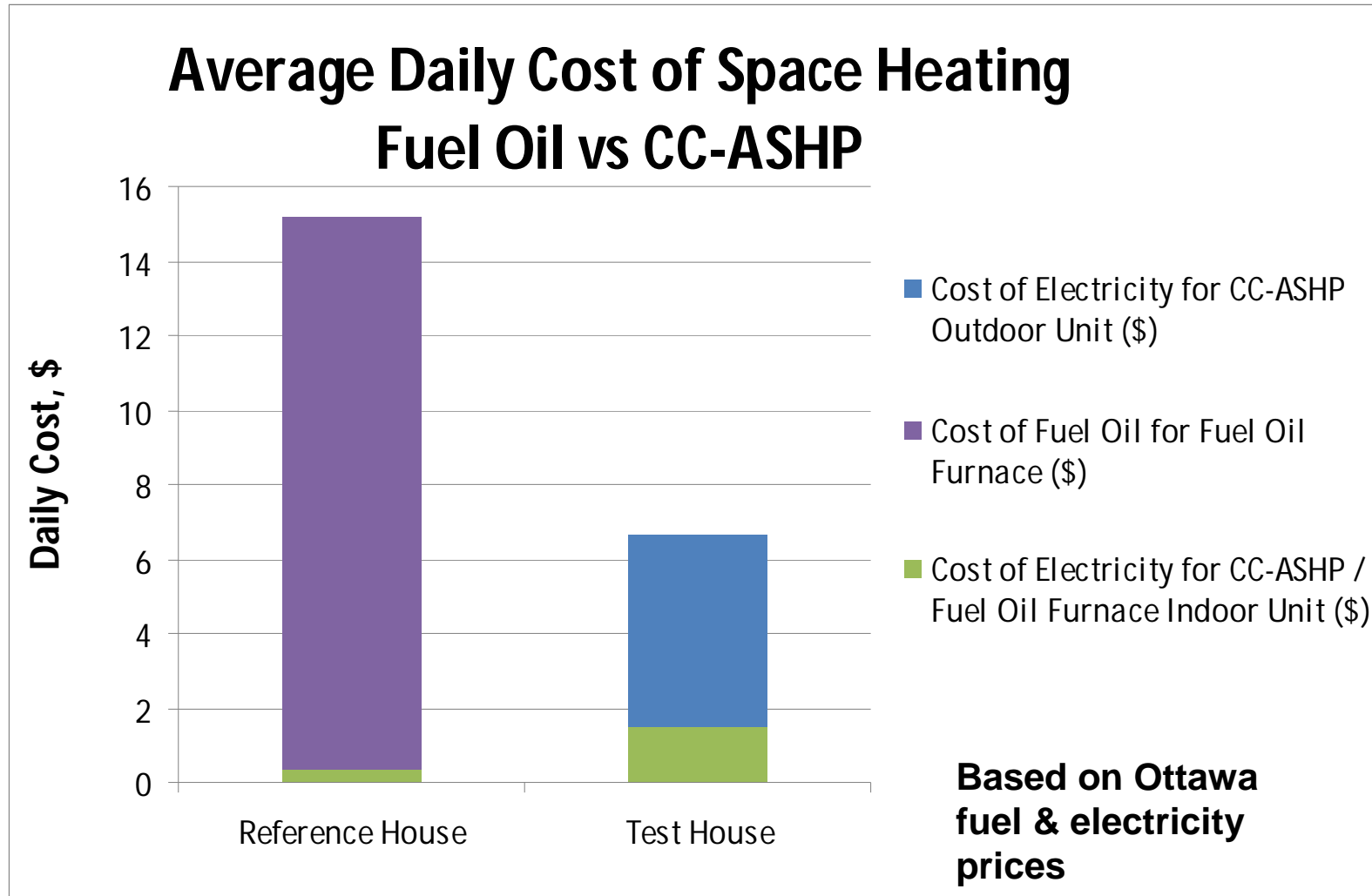
Operating Cost Comparison with Baseboard



- **Versus baseboards, CC-ASHP costs \$7.71 less per day, -54%**



Operating Cost Comparison with Fuel Oil



- **Versus fuel oil, CC-ASHP costs \$9.57 less per day, -59%**



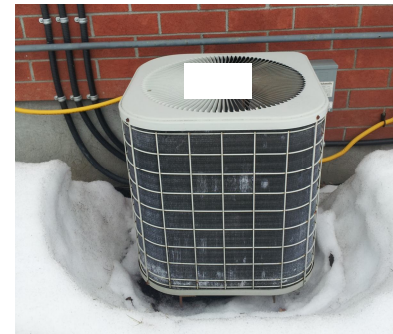
Ductless System Tested

Cold climate “mini-split” air source
heat pump

(2) master bedroom + living room



Central A/C +
furnace



- **60% energy savings in heating and cooling over gas**
- **Temperature swings 3 times that of furnace in heating**
- **Some method of continuous air circulation should be used in cases with closed floorplans (e.g., fully ducted HRV)**



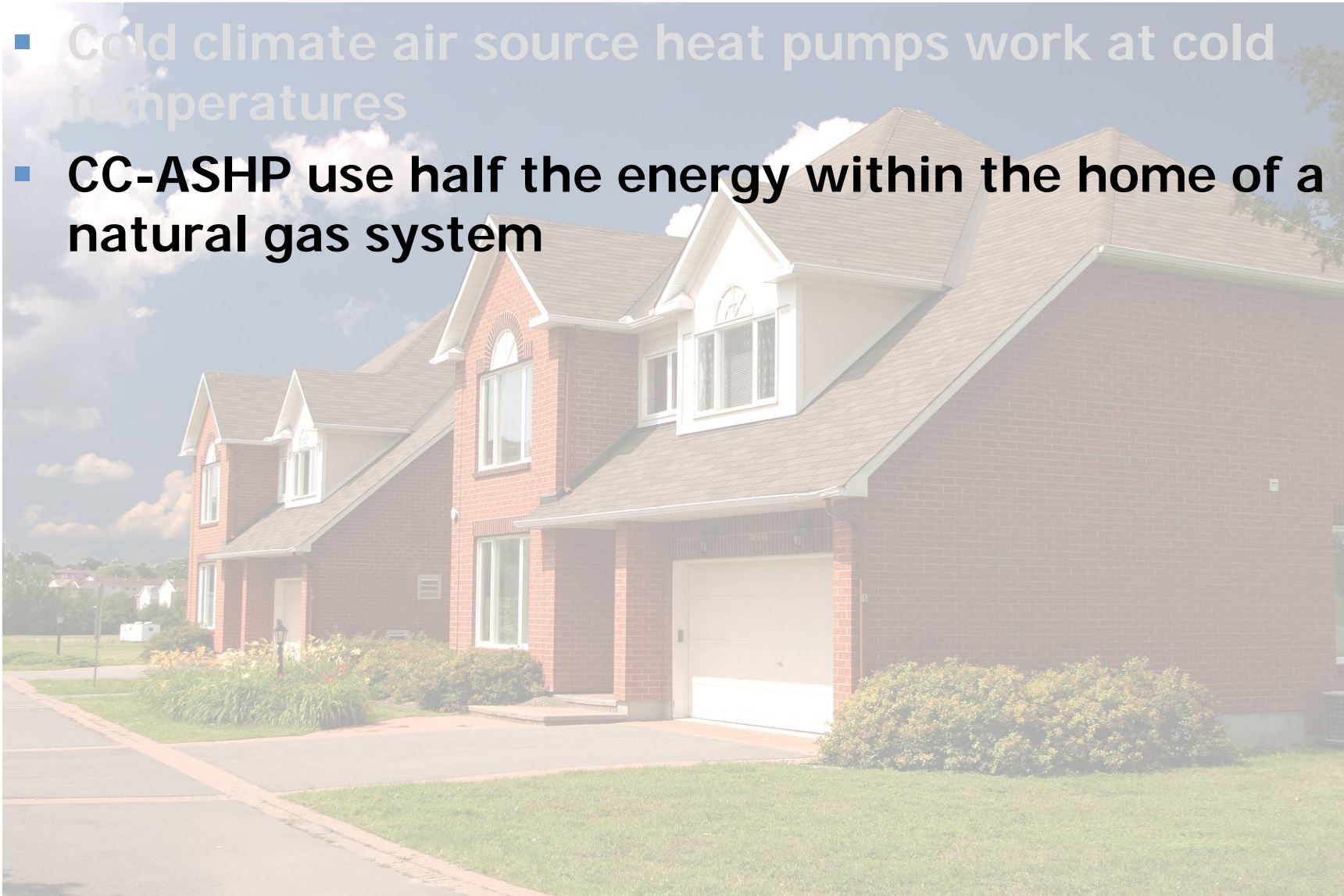
Summary

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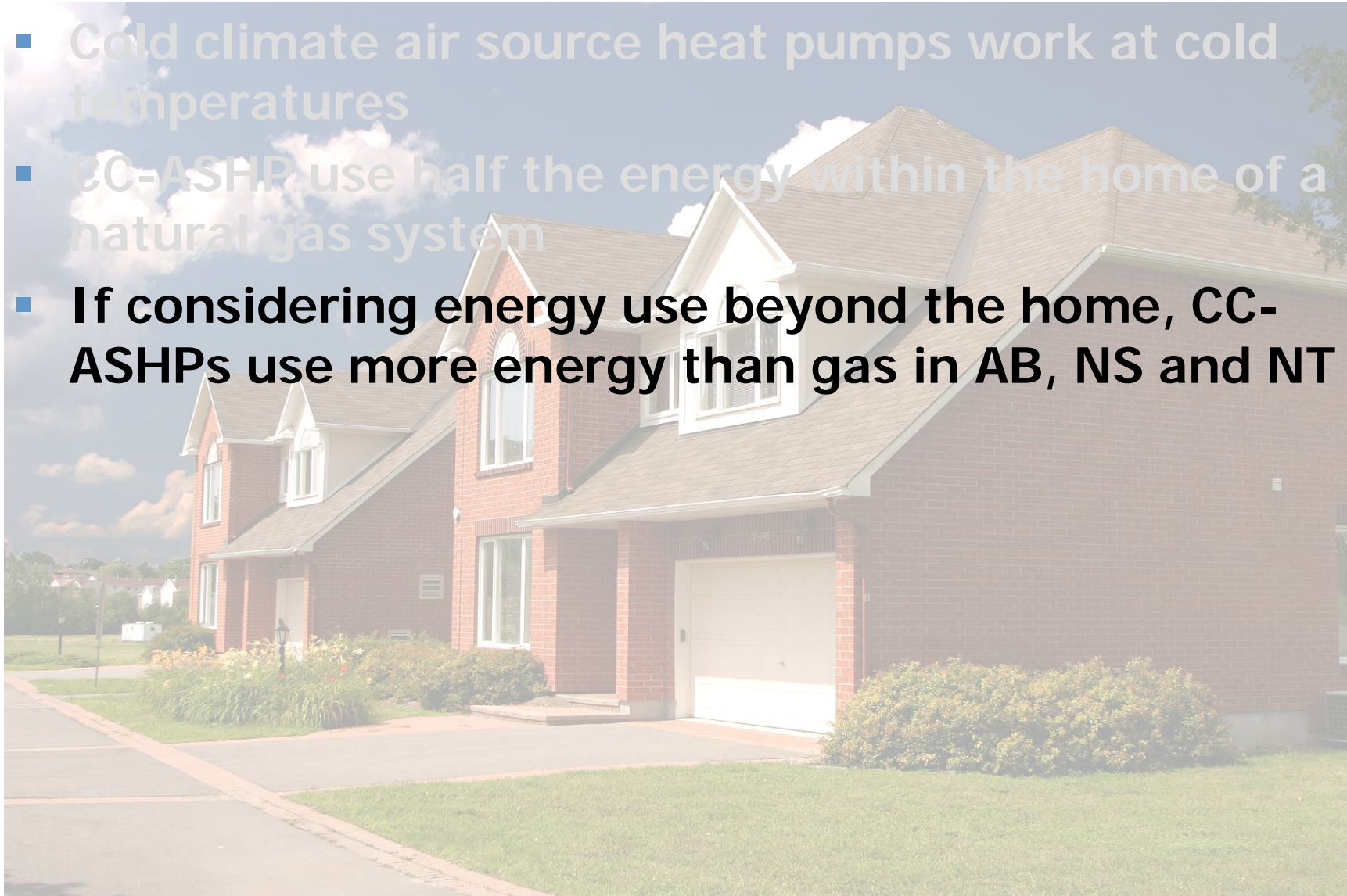
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Questions

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Appendix



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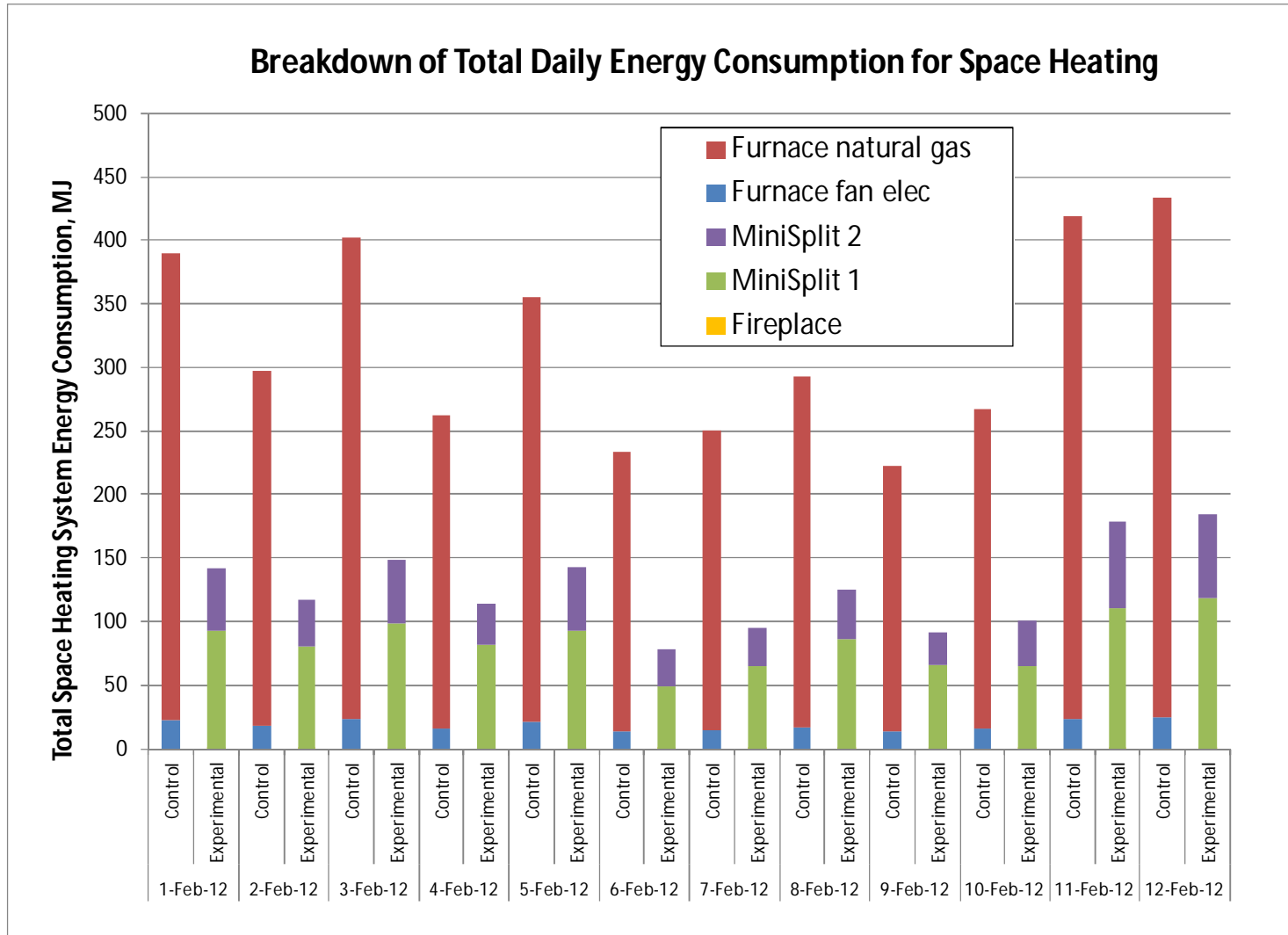
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Primary Energy Use

- Where fossil-fuel fired power generation is predominant, CC-ASHP is less efficient than gas furnace
 - AB, NS, NT
- If electrical grid has >20% hydro or renewables, CC-ASHP would be more efficient than gas furnace
 - BC, MB, ON, QC, NB, PEI, NL, YT, NWT
 - SK on margins



Mini-splits - Performance Comparison with Gas



Mini-splits - Comfort Comparison with Gas

Heating: Indoor Temperature Comparison - Dining Room

