

Are You Pumped Up? Achieving Widespread Quality Installations of Cold Climate Air Source Heat Pumps

- Stepping into the real world: How
do heat pumps work for our
customers?

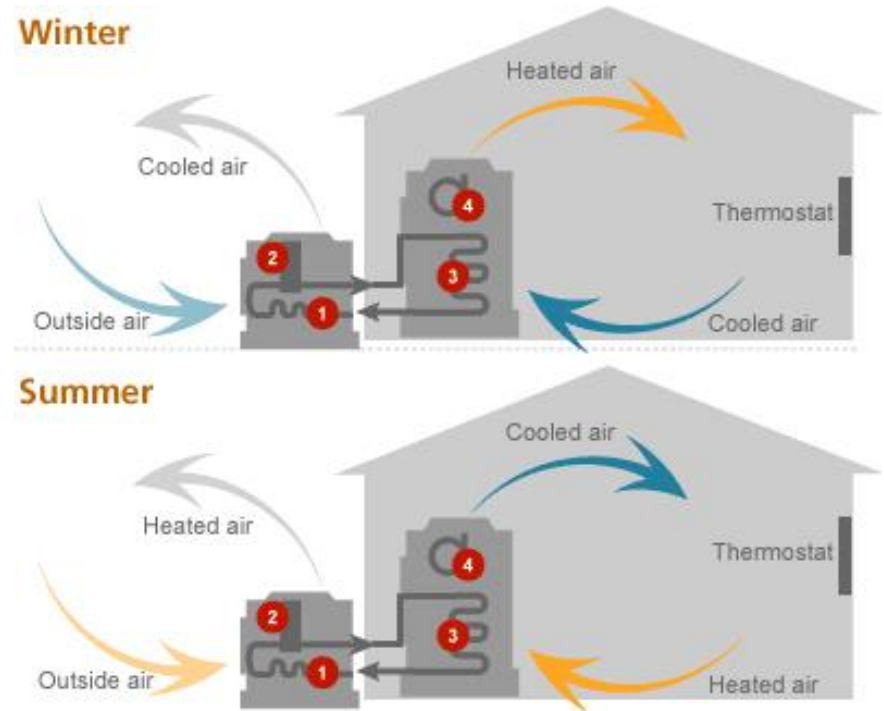
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Overview of Heat Pumps

- An ASHP uses a refrigerant system involving a compressor, condenser, and evaporator to absorb heat at one place and release it at another.
- Delivery of both heating and cooling via forced air distribution
- New generation systems can operate as low as -13°F
- ASHPs have the potential to deliver energy and peak saving as well as reduce reliance on delivered fuels.



Overview of mechanical systems and available performance metrics

- Inverter Technology
 - Much more efficient
 - ECM drive
 - Modulates to building loads
 - Very Quiet Operation, Inside and Out

Overview of mechanical systems and available performance metrics

- Cold climate performance rated
 - -13 degree F to -20 degree F
 - CEE has measured some working down to -25 degrees F
- Ducted vs. Ductless
- Zoning and sizing options are endless
- Variable Refrigerant Flow (VRF) systems
- Very Quiet Operation, Inside and Out

Ductless vs. Ducted

- Ductless



- Ducted



Zoning, sizing options, and VRF

- Many zones can be set up in homes and apartments
- Varying BTU sizing of ducted or ductless heads
- Many options for residential through commercial sizing for outdoor units
- Variable Refrigerant Flow (VRF) allows simultaneous heating and cooling of different zones

Ideal Multifamily uses of ASHPs

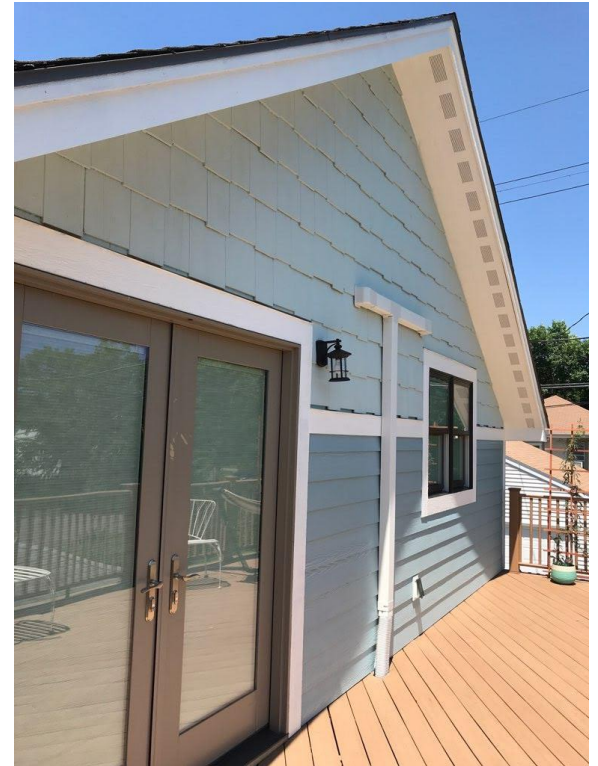
- Commercial VRF systems allow for very few outdoor units to serve entire buildings
- Ability to provide varying sizes of loads to different apartments throughout the day
- Cooling on South facing upper level can happen simultaneously with heating of lower north unit
- Advanced controls allow building management to control and monitor individual apartment settings
- Can be integrated with ventilation system to provide fresh air to all units through central ERV
- Small sizes can eliminate mechanical room in unit

New Construction Case Studies

- Accessory Dwelling Unit (ADU)
- Small Duplex
- Smaller Retirement Home
- Large Family Home
- Apartment

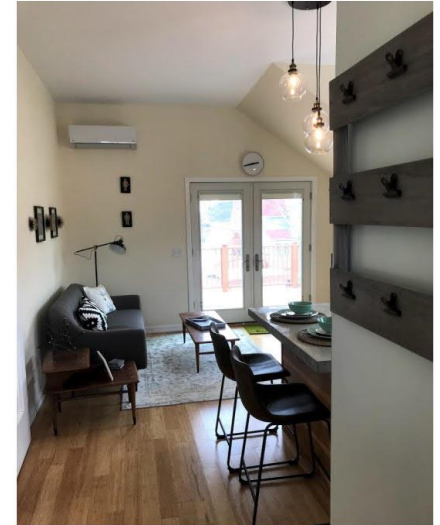
Accessory Dwelling Unit (ADU)

- Description – 650 Sq. Ft., 1 bed/1 bath ADU built above garage in back of city lot
- System – 2.5 ton, 2 wall unit heads in unit, 1 head in garage below.



Accessory Dwelling Unit (ADU)

- Client feedback
 - Estimated heating cost of \$500-\$600 last October-April
 - Remotes for heads are finicky and not user friendly, looking to replace with hardwired thermostat
 - Thinks sizing for code insulated building for heating led to some oversizing for AC. Had some dehumidification issues
 - Went with electric baseboard for backup heat, only needed once last year during polar vortex winter.



Small Duplex

- Description – Side by Side slab on grade Duplex, 1 bed, 1 bath each side, exterior insulation
- DOE's Zero Energy Ready Home rating, HERS 43
- Size – 530 Sq. Ft. each side
- System – 1 outdoor 1 ton unit per side, ducted system integrated with HRV
- 2 small wall mounted electric heaters as backup



Smaller Retirement Home

- Description – All electric, super insulated, passive house designed, 19,000 lbs of cellulose insulation, air tight, slab on grade, 10kw solar array, HERS 34 w/o solar, HERS -6 with solar,
- Size – 2052 Sq. Ft.
- System – 2 outdoor units, 2 heads-one up/one down, electric off peak backup heaters, sealed combustion wood stove



Smaller Retirement Home

- Client feedback
 - Been using heat pumps for 5 years, working well no complaints.
 - Use off peak heaters for much of load and wood stove for backup heat.
 - Passive solar design of home keeps quite warm during the day, no need for much heat on sunny days.
 - When heat pump on, typically using less than 1,000 watts, very low load, only puts out what needed. On 0 degree day, getting 85 degree air from wall head.
 - 9 of 12 months, utility pays them.



Large Family Home

- Description – All electric, super insulated, air tight (.12 ACH50 or 110 CFM@50pa), HERS 36 pre-solar
- Size – 5,100 Sq. Ft., 3 level with large solar array
- System – 1 outdoor 3 ton and 1 indoor unit, fully ducted air handler with built in electric resistance backup heat



Large Family Home

- Owner/Builder feedback
 - Owners have reported that heating and cooling have been working well, getting even temps throughout the home.
 - Builder done several all electric homes
 - Really likes the fully ducted unit in this one, and that there is single unit inside and outside
 - Previous disappointments with callbacks, service issues, and good tech's locally to fix
 - Controls-recommended simple programmable
 - Maintenance-check filters
 - Likes 2 stage back up resistance



Apartment

- Description – PHIUS rated, super insulated, air tight, 5 story, 59 unit, mix of 1, 2, and 3 bedroom apartments
- Size – 58,000 Sq. Ft.
- System – 12 outdoor commercial VRF units, individual ductwork system in each unit/space, integrated whole building ERV for fresh air



Apartment – Outdoor, Common, ERV



Apartment – In unit setup



Common Issues

- Client Expectations and Education
- Controls
- Outdoor Unit Placement
- Ductwork design and install
- Backup heat
- Commissioning

Client Expectations and Education

- Go through system workings of how works:
 - Zones
 - Controls
 - Backup heat
 - Homeowner maintenance
 - Service schedule

Controls

- Pick user friendly controls
- Go through how they operate
 - Settings-heat, cool, fan
 - Wireless handheld remote operation

Wired



Wireless



Outdoor Unit Placement

- Snow removal maintenance



- Hanging bracket



Outdoor Unit Placement

- Snow Stand



- Snow Stand with Roof



Ductwork Design and Install

- Properly size ductwork for CFM needed
- Seal ductwork with mastic/sealant
- Ductblast ducts to ensure good seal
- Install inside thermal and air barrier of home
- Install proper diffusers for good throw
- Easily accessible filter location for changing

Backup Heat

- Refer to manufacturer specs and ratings
 - Diminishing heating capabilities on coldest days
- Plan for backup heat needs on coldest design days
- Backup heat options include
 - Electrical resistance
 - Fuel fired appliances
 - Wood heat
 - Passive Solar
- Some manufacturers have backup heat incorporated into ducted systems

Commissioning

- General installation
- CFM of system
- CFM at diffuser
- Temperature – Delta T
- Static pressure
- Room to Room Pressure
- Installer set up
- Start up and operation
- Duct tightness test – duct blaster
- Home owner has been shown operation and maintenance



THANK
you!



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