Water Source Residential VRF Applications

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Geothermal: The Genius Renewable

Live at Groundwater Week in partnership with NGWA

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CEUs for this workshop

Be sure to scan the QR for Tuesday, Wednesday, and Thursday workshops to get points towards your IGSHPA certification CEUs.
Ideal Bread and Butter Retrofit Business

1. Ducted
2. Adequately sized ductwork
3. High headroom basements
4. Tight, insulated homes
Reality Retrofit Business

1. Very small ductwork sized for furnaces leaving air temperatures
2. Inaccessible ductwork
3. Low or no headroom basements
4. Old, leaky, uninsulated homes
Even still, many ductless homes in Northeast

1. 2,400+ total heat pumps installed
2. Nearly 40% of sales leads don’t have ductwork nor adequate access to install ductwork without major renovations
Very Difficult/Impossible Ducting Retrofits

1. Inaccessible crawl space
2. No attic
3. No headroom for going through finished space
4. Minimal mechanical space
5. Multi story house on slab
6. Entire home is finished so ductwork would be very disruptive
7. Unfinished spaces do not connect
There are many different ways to retrofit homes that use hydronic heating.

1. For a given choice:
   a. Which homes can we serve?
   b. What is the most straightforward way to serve these homes, meaning can we standardize our offering?
   c. How big is the market for those types of homes given the type of system we choose to install?
Hydronic family tree

- Radiant
  - Steam
  - Baseboard
  - Radiant floor
    - Under floor
    - In-floor
  - Hydronic fan coils (forced air)

hotter colder
Example Ductless Home

1. Two story, 1,950 sq ft home built in 1935
2. Mechanical room located in the basement.
3. Central gas boiler and baseboard throughout the home
4. Cooled by air source mini-split units, no ducts and no feasible solution to add ducts
5. Peak heating load calculated at 42,000 Btu/hr
   a. Measured 117 ft of hot water baseboard in the home
   b. Output capacity vs water temp:
      i. 47,100 Btu/hr at 160F
      ii. 32,400 Btu/hr at 140F
      iii. 19,300 Btu/hr at 120F
Evaluated 4 Ductless Options

- **Nordic WH-55**
  - High temp water-water geo unit capable of delivering 160 F water to the space
  - Non-reversible, meaning it can only operate in heating mode

- **Waterfurnace NEW-050**
  - High temp water-water geo unit capable of delivering 145F water to the space
  - Can be used for heating and cooling

- **Samsung DVM-S AM055**
  - Ductless geo unit for forced air heating and cooling.

- **Mitsubishi MXZ-3C30NAHZ2** (qty. 2)
  - Ductless air source unit (with HyperHeat) for forced air heating and cooling.
Ductless geo was the clear winner in terms of modeled performance

- Even though the Nordic WH-55 could supply nearly 100% of the annual heating energy needed for this house, the predicted performance was worse than the Mitsubishi minisplit equipment (which is cheaper to install and provides AC), which makes it a poor choice.

<table>
<thead>
<tr>
<th>Unit</th>
<th>Equipment category</th>
<th>% Sizing vs Peak Heating Load</th>
<th>Calculated Annual Efficiency Values</th>
<th>Heating energy from hp (%)</th>
<th>Heating energy from aux (%)</th>
<th>Aux peak demand (kW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nordic WH-55 (LLT=160F)</td>
<td>High temp water-water, non-reversible</td>
<td>106.5%</td>
<td>Avg Heating COP 2.48</td>
<td>99.1%</td>
<td>0.9%</td>
<td>12.9</td>
</tr>
<tr>
<td>Waterfurnace NEW-050 (LLT=145F)</td>
<td>High-temp water-water, reversible</td>
<td>81.7%</td>
<td>Avg Cooling EER 13.72</td>
<td>95.7%</td>
<td>4.3%</td>
<td>12.9</td>
</tr>
<tr>
<td>Samsung DVM-S AM055</td>
<td>Ductless geo</td>
<td>110.6%</td>
<td></td>
<td>100.0%</td>
<td>0.0%</td>
<td>0.0</td>
</tr>
<tr>
<td>Mitsubishi MXZ-3C30NAHZ2 (qty 2)</td>
<td>Ductless air source</td>
<td>130.1%</td>
<td></td>
<td>99.1%</td>
<td>0.9%</td>
<td>10.3</td>
</tr>
</tbody>
</table>
Ductless geo avoids the need to deal with old pipes

1. Water quality can be a big concern. The water in old systems can be very dirty.
2. In these cases, chemical flush is needed before tying into the new equipment to prevent corrosion and premature failure of the mechanical components.
3. Old piping can be in rough shape, meaning we may not be able to reuse it.
4. If you change the flow through old piping systems, it can lead to increased erosion in the pipes especially after flushing them with chemicals, which can eventually lead to leaks.
5. Piping replacement leads to a much more expensive retrofit, especially when the piping crosses through finished space.
6. Chilled water piping needs to be completely insulated.
7. Gaps in insulation anywhere in the lines will lead to condensation issues.
8. Refrigerant lines can be routed outside of the home, water lines cannot.
Samsung DVM-S Water product line

1. Allows for installing ducted and ductless indoor units onto 1 water source heat pump
2. Only water source VRF product on the market we could find that offers single phase electrical models
   a. VRF = Variable Refrigerant Flow
3. 3, 4, and 5 ton outdoor units available
Use case #1 - Baseboard radiator homes, duct runs not feasible

Solution: all ductless indoor units
Use case #1 - Baseboard radiator homes, duct runs not feasible.
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Lineset manifold

Lineset & ground loop piping
Use case #2 - Ductless mini-split homes, duct runs not feasible

Solution: All ductless indoor units
Use case #2 - Ductless mini-split homes, duct runs not feasible

Solution: all ductless indoor units
Use case #3 - Major duct modifications required homes

Solution: Put some portion of home on ductless units and the rest on existing ducts
Use case #3 - Major duct modifications required homes

Install photos:
Use case #4 - Ducts possible, but infeasible to connect all duct runs

Solution: If heat load fits on 5 tons or less, use multiple ducted air handlers.
Use case #4 - Ducts possible, but infeasible to connect all ducts

Install photos:
Use case #5 - New ducts only possible in ½ the house

Solution: ½ the house on ductless units, ½ the house on ducted air handler
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Solution: ½ the house on ductless units, ½ the house on ducted air handler
Advantages and disadvantages of ductless vs ducted in residences

Advantages:

1. Provides option when ducts are not feasible
2. Seemingly infinite combinations of indoor units depending on home needs
3. Take advantage of water source COPs vs air source COPs
4. Variable speed system with multiple indoor units reduces/eliminates oversizing in cooling risk

Disadvantages:

1. Noise in living space
2. Sometimes there is not a place on the wall or floor to locate a unit
3. These systems are quite a bit more complex than 1:1 ducted split systems so more time and training are required
Lessons Learned

1. Having a VRF multi-split water source system in Dandelion’s toolbox has proven to be very helpful for making projects feasible that would otherwise not be with ducts.

2. Installs take longer relative to ducted retrofits because ductwork is already in place. So when comparing with conventional options, be sure to compare to all new ductwork + heat pump with the VRF alternative.

3. The different noise of radiators vs ductless units in living space takes adjustment for customers to get used to. If they’re light sleepers, they may not get used to it.

4. Product improvements still needed:
   a. Refrigerant flow control when using fewer IDUs (residential vs commercial)
   b. Refrigerant phase change control for addressing noises particularly in oil recovery mode
   c. Energy Star certification still needed
Questions?

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Heating Piping Diagram
Cooling Piping Diagram