

Breaking Down the ASHRAE Headquarters Building Performance Data

The VRF system energy consumption is up to 80% higher than the water source geothermal system. Certainly a portion of the difference is the fact that the VRF system is air source and the water source system is ground source. But the difference is so high a boiler-tower WSHP application would be substantially lower cost and still more energy efficient.

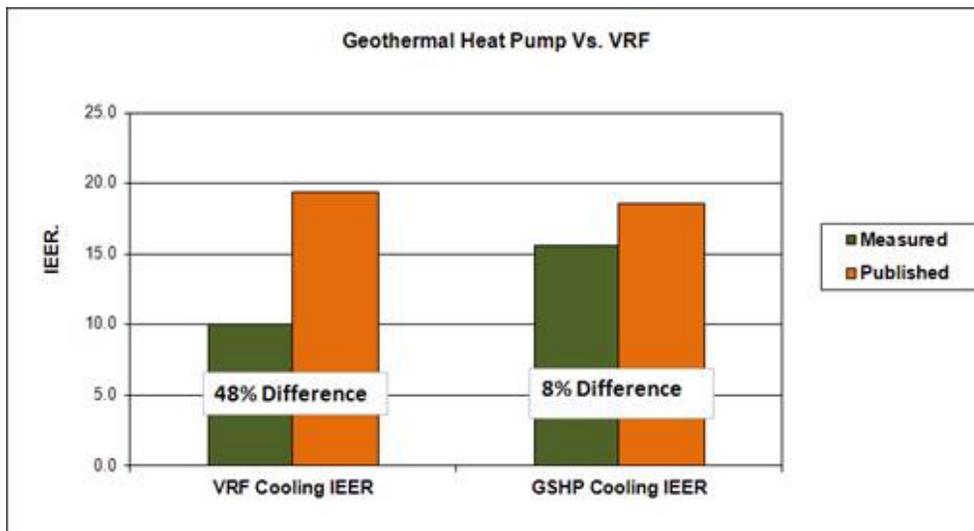
Per square foot energy consumption as a benchmark can be misleading depending on building type or use patterns.

However, A recent analysis of the data on the building was able to do what is necessary, measure the actual output of the systems.

*“Part two, Performance of HVAC Systems at ASHRAE HQ”
ASHRAE Journal, December 2014*

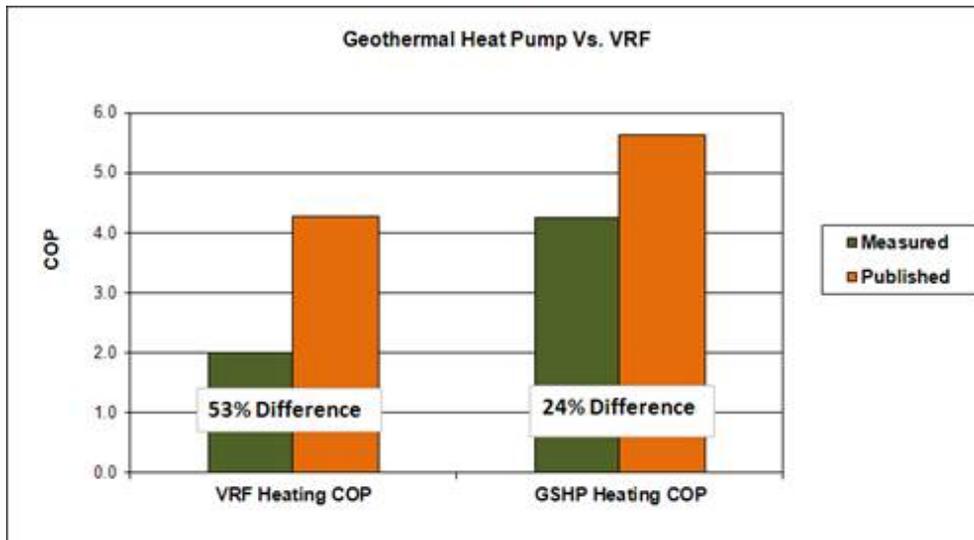
What the authors discovered was that the measured heating COP’s and cooling IEER’s for both the VRF and water source geothermal systems did not match up with published data. The VRF system performance claims “system performance”.

Following graphs compare the measured to published data for the two systems.



Note that for both heating and cooling the VRF system measured COP’s and IEER’s are 50% less than the published data. For the water source heat pump system the differences are significantly smaller and to be expected when system energy transfer – pump horsepower – is figured in to the system analysis.

About half of the discrepancies for the VRF system are due to the pumping energy as the compressor becomes the system pump. There is approximately 300 ft. of refrigerant pipe causing performance de-rate for the VRF efficiency in the building. This is approximately half of the difference between the measured and published data.



Additional loss of efficiency is contained in multiple de-rates for operation outside the AHRI test points, hotter or colder ambient temperatures. More are due to failure of the units to function at the part load conditions contained in the VRF created AHRI certification formula. An IEER in accordance with the AHRI test points assumes part load operation by fixed percentages and conditions that do not match building actual operation. There may also be credits for heat transfer that does not occur absolutely simultaneously as required within each condensing unit.

The WSHP efficiency is the unit – as a factory-sealed refrigerant circuit – so there are system functions as well as differences in actual versus AHRI test points which accounts for the WSHP differences to AHRI certified points.

In summary:

1. Water-cooled versus air-cooled, water wins
2. Operation inside test points for water-cooled versus operation outside tested conditions for air-cooled
3. Field refrigerant piping versus factory-sealed refrigerant circuit as tested/published.
4. Actual operation versus certification formula and operating point assumptions.
5. Failure to apply proper de-rates.
6. Consultants are not selecting equipment manufacturer IS!

If you lose a WSHP after 20 years you install a new one on the system.

When you lose a VRF condensing unit you have to replace the system all the terminals, piping, controls, as well as, the refrigerant unless an exact replacement is available.

VRF unit life is the system life.

Water – Sustainable for the life of the building.

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