Webinar 8: What is the System Efficiency of a Community Heat Pump System and How it is Calculated?
Q&A Report

Question Asked	Answer Given
In the example with hot and cold water circulating in the community loop, did you consider heat loss/gain from the loop to the ground?	Thermal losses were not accounted for, so results are optimistic for HW/CHW systems. I am not a fan of these systems as noted by beginning the presentation with the CBECS data indicating their energy intensity. My preference from an efficiency perspective is a ground loop for heat rejection/absorption with heat pumps inside the buildings.
Isn't the Pump Motor and/or the chiller motor heat in a space that may not be air-conditioned?	Yes, you can modify the program to correct for this.
I thought he said the tools (spreadsheets) are available?	http://geokiss.com/free-design-software/
A comment in lieu of a question. Thank you for taking the time to point out the low temp performance for other technologies, like VRF. These points are much appreciated.	Thanks, I try to provide information to balance exaggerated marketing statements.
Where can we get the calculation spreadsheets	http://geokiss.com/free-design-software/
is the spreadsheet available?	http://geokiss.com/free-design-software/
I think I see other mistakes on Slide 24: 64 20,000 CFM fans, 1,000 1000 CFM heat pumps.	Will provide a corrected slide.
He just gave locations of spreadsheets: http://geokiss.com/free-design-software/	To share with others.
What is the data for invertor duty heat pumps?	They typically will have slightly lower EER at full load with 86°F EWT in cooling. The COP in heating at 32°F ELT is typically lower but they will have higher full load capacity due to overspeeding the compressors (which reduces aux. heat required). At part-load the ratings are higher but actual performance is nearly the same as single-speed units when corrected to provide dehumidification in cooling and comfortable air delivery temperature in heating. VS units also will typically lower ADPI at part-load due to reduced velocity at the supply registers. See *Outside the Loop* newsletter (vol. 5, no. 2, p. 4, Projectile Dysfunction)
How do you account for variable water and air flow?	These are full load calculations. Demand will be higher and energy savings is dependent on having no oversized fans and pumps and controls working as intended. These are very poor assumptions, especially the one on controls. So the lack of measured data to verify results is problematic.
Have you compared a central dual-duct dual fan VAV with each duct conditioned with a water-to-air HP (for lower lift vs. hot water) to the distributed heat pump approach. There is a good maintenance cost argument for centralized air systems vs. hundreds of heat pumps scattered around the building. With proper duct sizing, larger better fans and better central control of ventilation could reduce overall energy use. DDVAV can be controlled to prevent simultaneous heating & cooling of zones. Your thoughts?	RS Means Facilities and Maintenance Cost Data shows the maintenance cost of a VAV terminal to be higher than a water-to-air heat pump of equivalent cfm. No I haven't considered this because: kW(fan) = 0.746 x cfm x in. wtr. / 6350 x fan eff x motor eff. Plug this into a calculator to see why large central duct systems with high ESP and filter losses have very poor system efficiencies.
For your system comparisons you only look at pumping and HP at full load / design conditions so you find the peak efficiencies. How would the seasonal efficiencies change if you took credit for part load operation of the VSD-controlled pumps.	The series on Long Term Performance of GSHPs found gross pump oversizing to be commonplace with delta Ts being 2 to 4°F at full load in cooling and 1 to 3°F in heating. One system had an 8°F in cooling but it was designed by the contractor rather than the engineer of record.
The speaker has rightly stressed the importance of measured data but does not appear to present actual, measured, data demonstrating that “simple, well designed and installed GSHPs” actually meet the kBtu/ft^2-yr figures indicated by red arrows on slide 9. Where is this measured data in the presentation? Is the red arrow a calculated figure?... if so, it is not appropriate to compare to measured data.	These data were provided in Webinar 7. See slides 24, 25, 32, 33. More detail is provided in the series of 7 article on Long Term performance of GSHP in the ASHRAE Journal. These articles can be accessed at www.geokiss.com
What is the difference between building diversity and “community diversity”?	Diversity is diversity. For the example I assumed 80% within each building and 80% building to building. Actual design should perform calculations to determine estimated values.

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Steve, when you went to Community Loop wouldn't building dP drop from 100' as they no longer need to pump through ground loops?	Answered during presentation.
Simply: How has ASHRAE missed/excluded key assumptions about static pressure in Standard 13256-1??	The reason offered by manufacturers is that this is an international standard(ISO) and Europeans prefer non-ducted systems. I'm sure they use filters but the standard does not indicate a correction for them. Note: Competing technologies have standards with loopholes so this may be a way of compensating. i.e. Std. 210/240 for ASHPs uses an indoor temp. of 80°F and a weighted average outdoor temp of 76°F to determine cooling mode SEER.
Is there is an urban building density above which it makes sense to have a community loop? What about community system connected via refrigerant lines? Is moving refrigerant a long distance feasible, what are the losses vs. a water/glycol loop?	This would have to be determined on an individual basis. It appears to be greatly influenced by the level of diversity. i.e. are you making ice for an indoor rink in the middle of winter when heating is needed in the community. Moving refrigerant long distances require large charges of refrigerant which have GWPs. This is counterproductive to minimizing global warming. When water leaks you probably know it. When refrigerant leaks maybe not. Refrigerant safety standards are stringent to avoid displacement of room air oxygen. Replacements like R-32 are also "mildly flammable". Not a good idea in my opinion.
Why are high SEER/HSPF machine's COP drop off steeper than lower rated machines?	Compressor speeds are increased athigher loads for VS equipment in some cases near 7000 rpm. Drop off in multi-capacity is marginal but extra components (valves, solenoids) do lower full load efficiency somewhat.
Although many individual heat pumps in a building can improve the overall efficiency compared to a central chilled water system (heat pump chillers) with central air handling units and VAV boxes, there are some concerns about the noise and maintenance near occupied spaces with local heat pumps. This seems to be an obstacle to use individual heat pumps in some types of buildings.	Yes it is of concern. Some manufacturers offer acoustic packages to minimize compressor noise. Air noise is likely to be similar to VAV terminals. Soft start EC motors minimize air noise change at heat pump start up.
Why are you comparing old chiller systems with the geothermal heat pumps? would a better comparison be with new higher efficient chillers?	The comparison was at full load using 0.5 kW/ton. The higher efficiencies you refer to are likely at part load.
Have you considered the impact of water side fouling factors on efficiency. As an example, the ARI performance test is performed with unused tubes with no fouling. In the real world the capacity and efficiency will be much lower if the specifier hasn't properly accounted for it.	This would be present in open loop systems and in closed systems with iron pipe, especially in applications in schools that typically do not have resources to maintain water quality. This is why the use of HDPE or fiber-core polypropylene for interior piping is highly recommend along with HDPE in the ground. Open loop systems should be isolated with a PHEs.
In the case of unbalanced heating and cooling loads, can you speak to using solar thermal or Cooling towers or open loop wells to precondition the ground loop or remove excess heat or cold. This also may help reduce number and cost of geothermal field	Yes, cooling towers, fluid coolers, ground water, lake water can be used in the cooling mode. I am not a fan of using boilers or water heaters to balance ground loop heat loss loads. Controls can be overridden (or malfunction) when occupants complain of cold conditions. Resulting elevated high temperatures can damage HDPE ground loops.
On pg 22, why did he leave the 20 bldg. pumps at 100 ft. if the 2 large pumps are circulating the ground loop?	100 ft. of head is to circulate in the central loop. Additional head is needed inside the building no matter which pumps provide circulation.
pg 25, also loose eff. with HW and CHW loops due to thermal losses.	Thermal losses were not accounted for, so results are optimistic for HW/CHW systems. Note than I am not a fan.
If district systems are so high in energy usage, why do owners still use them instead of systems in each building?	Good marketing, engineers that rely on computer simulations (often provided by manufacturers) without doing calculations, lack of published data to support decision making.

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Is it possible that the high energy use for district chilled water and energy management systems is affected by these types of systems serving complex, energy-intensive buildings (research labs, hospitals) and not an inherent fault of the system type?	Yes, energy intensive buildings do affect results. Unfortunately, many energy intensive buildings are served by HVAC systems with high static pressure fans and high delta P pumps. District systems add an additional high delta P set of pumps if design is not of quality.
Did I miss the assumptions that lead to calculated impact of diversity in loop? So many variables.	Yes, there are many variables. That is why the programs are provided for users to input diversity values resulting from load calculations for the proposed systems.
Any info on HX plate (or other equip) fouling with flooded mine water?	No data. I believe a flooded mine water systems was discussed in Webinar 2.
PV usually less that 15% efficiency. Solar flat plate collector panels (w/glycol) run about 80% efficient. And no hot water heating tank is needed. Comments?	see below
The Cornell deep lake cooling system has water temperatures that stay at a constant 39F. The lake is usually frozen over in the winter. This system displaces 16,000 tons of cooling year round.	Yes this was noted. It's an awesome system if pumping power can be limited. However, 39°F will have little heating value as indicated in slides 40 and 41 from previous Webinar 7.
PV usually less that 20% efficiency. Solar flat plate collector panels (w/glycol) run about 80% efficient. And no hot water heating tank is needed. Is the problem heat dissipation in summer? Comments?	In winter solar thermal systems will be near 20% **system** efficiency when heat losses and pump power are included. PV systems do not require pumps and have no heat losses to the outdoors. In the summer when heating is less in demand thermal **system** efficiencies can approach 50%. Thus, the PV area will need to be twice that of thermal collectors. However, PV panel cost per sq. foot are much lower, they require minimal maintenance and have service lives of 25 years. I am not aware of hot water systems that do not require tanks.
what do you feel the best use of the spreadsheet/calculators is? Is it predominantly to compare full load efficiencies only? How would you suggest these tools be used along with other energy modelling software?	These calculators are primarily for full load. They can be used at part-load if you desire but part-performance of any type of equipment must be corrected from rated performance to actual performance. I am uncertain of what is behind the curtain with energy modeling tools (especially those provided by manufacturers). The "Brits" seem to be more on top of the descrepancies. See *Outside the Loop* newsletter, vol.5 no 1, p 2,.Building Simulation vs. Metered Energy: The UK Experience.