



1. Are you going to get into the maintenance side of things? Many clients do not want air to air HP due to the very modular system, and lots of filters, etc?
  - a. There are filters to clean in the occupied spaces, and routine cleaning (spraying down) of the coil on the outdoor unit to maintain best efficiency. That said, any air conditioning or PTAC unit should have its filters cleaned regularly anyway, we just tend to ignore this need.
2. What is the best refrigerant to use for energy efficiency for a heat pump application?
  - a. It depends on what you're using the heat pump for. High efficiency cold climate VRF systems using R410a can be highly efficient options for heating and cooling. CO2 heat pumps for domestic hot water production can be very efficient options there. The climate and the end use are both drivers for what is best.
3. With such a green grid are purchases of RECs necessary?
  - a. I can't speak to whether any programs might still require them, but if you have a fully-electric system and you are on a perfectly clean grid, then your CO2 emissions would be zero.
4. Many of our clients don't care about the grid. They only care about the cost of systems, maintenance, etc. Are there health, cost, maintenance points to explore? Even SUNY is clear at the upper levels, but it is not yet grasped at all levels.
  - a. Yes, eliminating combustion on site improves local air quality. Operating cost is heavily dependent on the local rates, which vary across the state, so the operating cost has to be evaluated based on that. We have found that first cost for a VRF system can be comparable to a traditional boiler-based system. We have not priced out enough electrified DHW systems to have good data on those costs. Regarding maintenance considerations—non-combustion systems avoid a lot of maintenance and permitting issues associated with oil or gas usage. Heat pump systems are either packaged or split. Packaged unit refrigerant circuits are typically not maintained on site. Split systems are often maintained by service contractors, but site staff could be trained on that.
5. Are these systems designed for commercial buildings?
  - a. Within reason—there is commercial-grade equipment available but terminal units come in a set size range, so any extremely high load space would have to be looked at to see if its loads could be met with the terminal units available.
6. How is the efficiency of the pumping system related to the temperature of the water?
  - a. These hydronic systems all require pumping power, regardless of how hot the water is. Systems with high dT across the terminal units can get away with lower flow rates and lower pumping power if they are controlled well.
7. Why can't we just size the pump appropriately? Adding VFD's and TDV's to the project seems like unnecessary cost to the owner if the pump is sized properly.
  - a. Yes, this is the issue – we should be sizing pumps properly but many projects are still relying on VFDs and TDVs to get to their target flow rates instead.
8. How do you know when to provide AC's in addition to heat-recovery loops (so that you're not working against the gradient)?
  - a. Heat pumps can work against gradients, there is just a technical limitation given the heat pump used.
9. Are there any concerns with biologically active organisms (legionella for example) in low temperature hydronic systems?
  - a. We do not worry about Legionella in closed loop systems. Closed loops can be chemically treated and people are not exposed to the water in them. Open systems where people are exposed to aerosolized spray are the main concern.
10. Have you been able to retrofit and reuse existing plumbing infrastructure and implement the ASHP+WSHP+DHW approach?
  - a. We have not executed it yet, and are currently studying it under a NYSERDA grant. The primary consideration is that existing and proposed terminal units need the same flow rates, which is likely. Where your pre and post retrofit systems need the same flow rates then your plumbing should be sized appropriately for the new system.



11. Is Brown still planning to change central plant to RE supply? I thought that was the plan...and their study revealed what buildings needed to be renovated first in order to make that transition. Or I may be confused with Stanford!
  - a. I was told that they are still developing a final plan.
12. for HPWH performance graphs - is the x-axis really entering wet bulb?
  - a. These graphs come directly from the manufacturer. It should be the ambient air, which would be the air being pulled across the coil.
13. Do you have backup for this CO2 chart?
  - a. Assuming this is the graph from slide 106? This is a simple calculation with the inputs of NYC carbon coefficients, equipment efficiency, and a given constant DHW load per SF. There is no modeling involved, just a quick equation.
14. What about GAX for DHW?
  - a. Not sure what GAX is short for.
15. Are there any design guides or software available?
  - a. California is working on a DHW design system that generates central plant designs, but I do not believe it is out yet.
16. On a natural gas condensing boiler on demand do you need a mixing valve?
  - a. You can set the unit to produce supply temperature water and not mix it down.
17. I recently heard that some people are varying the DHW temp in the tank to 140F for one hour per day to "kill off" the legionella and keeping a lower temp (of say 120) for the rest of the day. Does that work / does code allow that?
  - a. I don't believe the code language is very rigid when it comes to Legionella. ASHRAE and OSHA both point to flushes or short term temperature raises, but there is no one uniform approach given. This means I can't tell you what the answer is, just that I take the conservative approach of maintaining 140F in the tanks. ASHRAE Guideline 12, WHO, and OSHA discuss this.
18. Is anyone combining light weight solar pumping with a tank?
  - a. Solar thermal and heat pump systems can be combined but typically they aren't just because it can be challenging. Many heat pumps are sensitive to inlet water temperatures so preheating with solar can harm the heat pump efficacy.
19. CAR dampers?? Is that a brand? Acronym?
  - a. CAR – constant airflow regulator. There are several manufacturers providing these in the US.
20. With new Energy Code...aren't we really pushed to LED? They are ready. Certainly.
  - a. LEDs are certainly available and many sites have already converted. We just want to make sure everyone is using the same language when talking about them and is clear on the other factors like color, brightness, and controls.
21. Also re: controls...good controls, understandable to occupants as well as operators. Just a thought.
  - a. Agreed.