

EMERGING TECHNOLOGIES SHOWCASE WEBINAR: CO₂ HEAT PUMP WATER HEATERS

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Question and Answer Session

Q: Is there a lower temperature limit for the outdoor unit? And does the linear COP trend continue below 17°F?

A: That's what the field research is hopefully going to find out. We are looking particularly at the data from our cold sites. The schedule takes us through another winter besides this one so we have a real good chance of finding the answer to this question.

Q: What is the risk management to prevent the exterior potable water lines from freezing?

A: In the present installation setup, the lines are insulated from the point that they leave the tank until they get to the outside unit and then all the way back. When they go outside of the conditioned space, the lines are also protected with electric resistance heat tape, which is thermostatically controlled. There is also a freeze-protection cycle built into the outdoor unit. It knows how to defrost itself. It also has a cycle that protects the heat exchanger against freezing which will protect the pipe runs.

Q: What installation protocol is followed to keep the water from freezing when pumped from the outdoor unit to the tank? Will there be something in place?

A: We first tried to install the outside unit as close to the building as possible. The Tacoma installation is several feet away because we had to go under a deck to get to a place we could put the outdoor unit. The protocol is simply to insulate the lines and protect the heat tape. The weakness in this design is if the power goes out for extensive periods. That danger was pointed out by Mike Lubliner, on the WSU Energy Program staff, and it's something that Sanden is going to have to look at in designing a product that's not designed for Australia but for the Pacific Northwest.

Q: What are the costs of these units?

A: We don't have costs for a unit that is designed and UL-approved for the United States, so I can't really answer that question. The Australian unit, as I understand it, sells for just under \$3000. The installation cost averages \$700 on top of the cost of the unit. I know that the 40-gallon unitary system made in France is less expensive. I don't know about its installation cost.

Q: Will the Demand Response characteristics require an AMI platform?

A: The demand response project we're doing with Bonneville has a requirement to look at the CEA-2045 protocol (editor's note: see CEA-2045 webinar 9/23/2014). This is being worked on between Sanden and the Bonneville Power Administration. Yes, the intent is to have them acting as if they were utility dispatched.

Q: If the results from these 4 sites prove to be as positive as it looks like they will be, what is the next step for field testing? Will this be done with a larger sample group?

A: I think that there will be a larger sample group but first we have to get a US product. According to an official public announcement by Sanden, they plan to introduce their units in the U.S. market January 1, 2015.

Q: What are Sanden's plans for manufacturing these units in North America?

A: Sanden is a very interesting company. They not only produce heat pump water heaters in France, Australia, and Japan, but they also produce and are one of the world's largest manufacturers of compressor systems for automobiles. They produce all of General Motors compressors, many for Japanese manufacturers as well as Volkswagen BMW. In fact, BMW is currently working with Sanden to have a CO2 refrigerant compressor in their automobiles. They also make vending machines, including approximately 30% of the vending machines in the United States. They are busy converting those, on an initiative by Coke I believe, to CO2 compressors. The company is going to be working with us, I believe, on getting this product (CO2 heat pump water heaters) to the U.S., which is being built in their manufacturing system in Texas, Detroit, and Northern Mexico.

Q: How long do you think it will be before this technology is approved for sale in the U.S.?

A: As I said, January 1, 2015 there will be a product for sale. They are busy using the data collected in the lab test and especially the field test to help design those units.

Q: The current units available are 50 Hz 240 V. What did you do to allow them to be installed in homes in our region?

A: Interestingly, we thought we would have to convert that 50 Hz to 60 Hz. The 240 V is standard. It turns out that you can directly connect a unit which is a 50 Hz compressor to a 60 Hz system without any problem at all.

Q: Do you believe an electric resistance backup element will be required for use in the Pacific NW?

A: I don't believe it will be required by law. But it probably is required for marketing purpose. And it might also be useful for demand response.

Q: Are there commercially available CO2 HPWHs on the market right now for the U.S.?

A: Not to my knowledge. When we scoped this project originally, we worked with some of Japan's leading manufacturers of CO2 HPWHs. They had no plans to bring this technology to the U.S. The only company we found that wanted to participate in the project was Sanden.

Q: What are the percentage reductions in COP if you consider the energy of heat tape? This will vary with climate and installation. It will be interesting to see the monitoring of the heat tape circuit.

A: We are monitoring the heat tape circuit. We're monitoring all the power that goes into the HPWH, and I forgot to mention that we're also monitoring the heat tape. So we'll have a very clear picture of the actual performance of the system.

Q: Can you describe the defrost details for the outdoor unit?

A: I do not have information right here, about the defrost logic for the outdoor unit. It has two functions. One is a standard defrost cycle for a heat pump in order to keep the heat exchanger from icing up. It also has a special warming cycle through the heat exchanger to protect it from freezing.

Q: Are you planning to look at the applicability of this technology for space heating?

A: We are indeed. In fact, Sanden is currently making, for its Australian market, a version of the water heater that we are testing that is set up as combined space heat and water heater system. The loads are so small in Australia that that is feasible with the output of this system. They are also designing one for larger loads in North America.

Q: How long has this unit been produced in Australia?

A: Five years.

Q: Why was the high operating PSI of the unit a concern? (This was mentioned in one of the first slides)

A: There is, in this country, a standard requirement that pressure systems be able to contain three times the pressure that they're operating at. The problem with 1400 PSI in a consumer product is that getting to that safety factor is very expensive, maybe prohibitively expensive. There are other ways to make the units safe and we actually have a unit in the lab that lost its charge and nobody knew it. It isn't an explosive kind of release. It's very quiet and sneaky. If these things are protected with the proper pressure relief system and built durably in the first place, I believe they are safe. One reason that it's taking BMW and Sanden a year to bring the automotive CO2 compressor to market is because it's a different scenario than a stationary compressor such as a water heater or vending machine. When you put this compressor technology in a vehicle, it's subject to lots of different vibrations. To be able to handle and assure safety under this vibration, they had to redesign the unit and that's why it's taking a year to bring it to market.

Q: What is the expected life of the system? (You had mentioned the tank life being 20 years – is that the same?)

A: I don't know the expected life of the system. I have asked Sanden since their Japanese unit has an identical compressor system to what is being tested here in the U.S. by us, whether they have durability and function data from the installations in Japan where they have thousands of these and they've been in use for a long time. I'm sure when they bring this thing to market they'll have the data. And probably when they go before the RTF to ask for the provisional UEM, they will also bring this data with them.

Q: Do you believe U.S. systems will be designed for hydronic heating as well?

A: I believe that we'll be working these details out. I think that hydronic heating is being looked at by Sanden.