Q&A Report: Community Heat Pump Systems: What They Are and Why It Matters to You

Question Asked	Answers
What about distributed interconnecting plants and a decentralized loops connected to gether in a common main loop, will that be considered as a cmmunity heat pump system form the utility definition point of view?	How a community heat pump system is defined is left to the developer of that system. Several models were presented and the attendee is referred to: Overcoming Legal and Regulatory Barriers to District Geothermal in New York State – Final Report prepared by NSYERDA by Pace University, Pace Energy and Climate Center, June 2021
Is it worth adding water to the ground in the example of the big box store?	I assume that the question is referring to adding water to the soil that was drying out? There has been some work on this by Chuck Remund relative to slinky systems. You may want to search on those two names for more information. In the example shown the slinky was under the building. Adding water could possibly impact the soil conditions upon which the foundation was designed. I suspect that answer is: It depends on the soil type and the heat load imbalance.
Great talk Lisa! Would you say that the inclusion of both GHPs and Solar PV in a community system first occurred in a 3rd generation system or in a 4th generation system?	Good question. From Slide 11 it looks like PV is 3rd Gen and Heat pumps are 4th Gen.
Are BTUH meters typically used at each apartment unit for calculating utility costs owed by the tenant for central systems. How do owners of a muti-building development compile this information every month. Can this be provided by to the BAS	BTUH meters are one way to measure consumption. Others may simple charge a connection fee. This is a good question for future presenters How that works with BAS or other external billing system is beyond my area of expertise.
They question is probably not thinking about reversing chillers or modular reversing chiller delivering hot or cold water in the building even if the water in the district is ambient	It is unclear to me what the question is here. Six-pipe systems or simultaneous heating (condenser side) and cooling (evap side) are certainly a type of community heat pump system design for a central plant. Central plans heat pump systems will be discussed in an upcoming Webinar.
Heat pumps can be water to air and water to water is the point they are missing The district isolates the building from outdoor air temperatures. The heat pumps work against the loop if it is ambient.	This is statement not a question. Thanks for sharing.
The purpose of the district is to make the system in the building easier. The district requires more communication and training. The per building central heat pump can interface with most common HVAC systems. The building system is not limited to individual water to air heat pumps. There needs to be WSHP training and capability session	This is statement not a question. Thanks for sharing.
Ambient ground temperature - not ambient air temperature	
Does the ASHRAE decarbonization task force for have resources that talk about ethics for situations where engineers realize the ethical need to reduce emissions and wants to design building systems for it, however other members of a project's design team or the project owner are not interested in following a city's recommendations (non-legally required) for building standards to reduce emissions for 2030 and 2050 targets.	This question should be directed to the ASHRAE Task Force.
I'm curious about heat pumps for creating hot water. This may be due to the limitations of HPs, but I don't see them in the larger sizes, comparable in scale to gas boilers for medium to large projects. Do you see any progress on this front? or are solutions available I'm not seeing.	This is a good question. With HPs there typically needs to be more storage. For a drop in replacement it may not be the same footprint. You might look at Colmac for a more commercial application.
Please talk high level about how you initially size and modify in the future the central plant to balance the initial heating and cooling load hours and future load hours as a system changes over the years.	Central plant systems and their design will be discussed in an upcoming Webinar, also Webinar #3 will discuss loads for planning purposes.
What do you think of investors that want to start an efficient district energy system (ambient) and start it out with a large cooling tower and turn down boiler. As the system expands to multiple buildings that tie in, it will have access to more and better properties for geothermal.	I think investors are going to want to see a phased implementation plan with the installation costs, operational costs, maintenance costs and return on investment clearly laid out for each of those phases.
Based on your experience, are most energy imbalance issues result in the loop running too hot or too cold? I imagine this might be geographically dependent, but let me know. Thanks.	Energy imbalances are due to the building loads. You are correct that it is geographically dependent. Surprisingly with the increasing efficiency of building materials and the fixed internal loads, even colder climates tend to have 'cooling dominated' systems. An experienced engineer will size the ground loop to address this imbalance or look at ways to offset the imbalance by hybridizing the design. This is one of the advantages to district heat pump systems: the ability to move BTUs around to where they are needed.

I think engineers in the northeast might be cautious of designing buildings that solely rely on heat pumps for building heating. Will heat pump technology progress enough to reliably heat a building during those back to back 0 and negative degree days?	I (Dr. Phetteplace) addressed this question briefly during the Q&A period. I can only repeat that experience has shown that heat pumps, especially ground-coupled units, are able to operate successfully in cold climates. There are many systems operating in the northern states of the Midwest, as well as in Canada. For commercial buildings also please refer to the previous question.
Are there any environmental concerns on using bodies of water as a heat sink? Can you use a man made pond to achieve a heat sink?	Yes, the local AHJ may have specific requirements and should be consulted for any heat exchange with the earth, ground water, or body of water. Refer to ANSI/CSA/IGSHPA C448.5 - 16 for guidance on Surface Water Systems.
In answer to the question about 160 F water - yes there is. We just proposed a system at 185 F.	Thank you for sharing this information.
how much of ny energy is presently from a renewable source? thank you	It is not clear to me what this question is in reference to. If you are speaking of the renewable fraction of the electric supply, I'm sure the state will have those numbers for you.
what are the proposed energy savings for a common plant?	This will vary on location and plant design.
You have to provide the incentive to the developers of large developments who can prove this concept. Then we could start to consider retro-fitting this design into existing communities.	This is statement not a question. Thanks for sharing.
Isn't the existing building design temp a very big obstacle to conversion to GSHP? Is their any development of GSHPs that can supply 160-175 degF water?	The existing building design temperatures are of key concern when looking at the conversion from a higher temperature water source to a lower temperature water source in an existing building. There are ways to manage this but are they cost-effective? That is for the engineering team to determine. Several attendees mentioned GSHPs with higher temperature ranges. I will look into them for inclusion (not brand by type) in an upcoming Webinar. Also note, that in Europe central station heat pumps are suppling district heating systems with temperatures in this range.
Is there any research on trading off the greater efficicency of GSHPs with a more insulated shell plus ASHPs?	I believe the TVA did some research with Habitat for Humanity in Alabama or Georgia. You might look of that information in addition to the PI David Dinse, P.E. I seem to remember an ASHRAE presentation on this.
Is it "economcally viable" to tear our our existing building distribution systems to put in low-temp terminals and supply piping to individual terminals? The existing building stock is the elephant in the room.	Refer to my response to your first question.
Have you ever encountered an issue with a government entity over the thermal pollution (overheating) of a natural body of water?	I have not personally but I know there have been cases where a study had to be done. I seem to recall perhaps the housing development Lake Las Vegas and possibly Cornell University?
Could you briefly show (10-15 seconds) slide 38 on Single property district energy applications again at the conclusion of the presentation?	n/a
Obviously this makes much more sense to do with new communities or buildings. Can it be economically feasible to retrofit a community heating system with a geothermal community loop?	I agree that new construction would seem to be easier to apply this type of system to; however, there may be existing source or sinks nearby that could prove to be beneficial. For example, in the presentation I mentioned the Facebook data center heating a nearby residential community. To answer your question, it depends. What are you trying to offset in your existing community heating system (oil, gas?)? What are you asking the geothermal loop to do? Is the reason for this retrofit due to concerns of safety, the environment, or operating costs? And as noted in response to a question above, central station heat pumps operating in district heating systems in Europe are suppling temperatures that would be compatible with most hot water based building heating systems.
Is there grants for communities to update the r values in buildings before going forward with heat pump systems	I do not know. Please visit https://www.dsireusa.org/ to see what is available in your area.
Agree, great presentation. Will you be covering advantages/disadvantages of 2-pipe vs. 4-pipe systems in a future webinar? (In other words, hot/chilled water loops vs. ambient temperature water loop?)	Thank you. We still have a lot of things to talk about and I suspect your question will be answered during the upcoming Webinar on Central Plants and/or Geothermal 101.
The recent IEA report summarizes the current status of the low temperature DHC systems. To mix the inevitable murban mix of non-retrofitted, retrofitted and new buildings, and hot water services, a compromise feed temperature is for the network is about 65 deg C.	This is statement not a question. Thanks for sharing.
All the successful community DHC systems worldwide are operated by a municipal utility. Why do we struggle in copying this model?	It is because many of these system have local community and government support. In the USA everything is profit-driven. Now with concerns about GHGs there may be enough support in our country or in specific location of our country to support these larger, bolder, projects.
How does the regulated system differ from the unregulated system? Do both require utility grade meters?	Please refer to: Overcoming Legal and Regulatory Barriers to District Geothermal in New York State – Final Report prepared by NSYERDA by Pace University, Pace Energy and Climate Center, June 2021

We're starting down a path toward carbon neutrality for our 40 million SF of university buildings, I agree a key decision is systems temps. Can you speak to shift from traditional to 180/160 HHW to MTHHW or LTHHW - lower temps require more building modification, but with higher efficiency. I'm advocating for low temps - like 120F HHWS	This is a great and very pertinent question, but the response to this question is closer to a report than a paragraph! There are a range of solutions for retrofit options for the buildings, and the more envelope upgrades that have been done the more options you will have. Also, as noted in response to a couple questions above, central station heat pumps operating in district heating systems in Europe are suppling temperatures that would be compatible with most hot water based building heating systems.
thank you ! Question: Doesn't the fact that we are using bodies of water as sinks/source affect the wildlife in it? Fish, frogs, etc.	We should not impact the local ecosystem and this is an important part of the design process. The AHJ should be consulted for specific requirement regarding heat exchange with the earth, ground water, or body of water. Also refer to ANSI/CSA/IGSHPA C448.5 -16 for guidance on Surface Water Systems.
Lisa, if I am in hot & humid environment have 10000 CFM outdoor air returned at 85/78 F with about 1000 spectators and Shamu for display and maintain space temperature 82 with large water tank. can I use heat pump and have controls by dew point temperature.	This is a very specific question. If you are designing for temperatures which are within the capabilities of a heat pump there should not be a problem achieving your design criteria. The question to you as an engineer is: is this the correct application for a heat pump based on the owner's project requirements?
question is how good will be dew point control with heat pump.	See answer to previous question.
Do you have any examples of where multiple building owners came together to create a small, private district system? How did that come about?	I personally cannot cite an example of this for you.
In response to previous decabonization concern: With heat pumps greater COPs, compared with less than 1 of natural gas, total green house gas emission can be reduced by electrification, even if electricity is produced using natural gas. Doesn't quiet work out for coal heavy grids.	This is really a comment more than a question.
The photo showing a Ground Loop was described as being installed underneath a new building. What about that same loop design, but under a parking lot? I thought those were more successful.	This type of system could be applied but take care to account for solar gain by the dark parking lot materials and their affect on the top 5-6 feet of soil beneath that parking lot. The temperature swing will be much greater in the summer and may heat up your loop (this happened in a system as you describe south of Sacramento, CA).
What is an optimal temperature range for ambient loop systems? And how prevalent are ambient loop systems today?	Optimal is a subjective term; however, I refer you to a comment by Peter Garforth above.
where all do community heat pump systems exist in US today ?	That is a very opened ended system. There are some in British Columbia, Colorado, California, Texas. I hope you attend Webinar #2.
Are hybrid heat pumps a good stop gap measure? i.e. use gas for heating above a certain ambient temp in colder climates .	If the goal is to get away from gas to reduce GHGs, then I would not recommend this. Also, there really is no need for them if a ground -coupled heat pump is properly designed for the application. Such "hybrid" systems also invite abuse of "the emergency heat mode" when the user fails to understand issues like recovery from setbacks, etc.
Is there any opportunity for air source heat pumps to work in conjunction with these district geothermal systems? Similarly, would any refrigerant be used in community heat pump systems?	In a way air-cooled chillers are like air-source heat pumps. From that perspective they might be included but certainly not for heating application. I'm not sure I understand the second question. Are you suggesting a community variable-refrigerant-flow system? My response is that I would never do that.
Is there a example figure depicting increased power costs vs. increased differences between a steady ground temps vs. increased outside temps. This would help to sell GSHP systems to those concerned with payback yrs.	This question is very specific and certainly might be created but it is outside the boundaries of this particular series. I did a talk for IGSHPA several years ago laying out a method for comparing air-source to water-source because for clients because the equipment rating tests for each piece of equipment is different. I could not find the presentation on the IGSHPA YouTube channel. I suggest you refer Dr. Kavanaugh's website. He has several articles on this topic there for you to peruse: https://geokiss.com/technical-info/
who would pay for community heat pump system? will it be the same way DC and DH providers charge tenants?	See previous questions on the same topic above.
What limitations have you seen as far as heat rejected / heat absorbed for natural water sync sources? Is there a good rule of thumb or range of temperatures that you want to avoid keeping the natural environment in mind. I would expect that certain EPA type authorties would be involved with these systems.	The local AHJ may have specific requirements and should be consulted for any heat exchange with the earth, ground water, or body of water. Refer to ANSI/CSA/IGSHPA C448.5 -16 for guidance on Surface Water Systems.
What is the overall system efficiency when you combine solar thermal and PV with GSHP vs. GSHP alone?	That is a very specific question and many more detail are needed to answer. Those analyses are beyond the scope of this Webinar #1.

NYS is currently a bit short of 30% renewable electricity generation - about 2/3 of that is hyrdo. Another ~30 % is nuclear. Questioner should google NY Gold Book https://www.nyiso.com/documents/20142/2226333/2021-Gold-Book-Final-Public.pdf/b08606d7-db88-c04b-b260-ab35c300ed64	Thank you, Bill!
Given the high COP of geothermal systems, in NY gshp systems are currently net positive for GHG emission reductions even in parts of the state with the dirty electricity generation. It will only get better as NY makes its way to its 70% 2030 goal, Offshore wind off Long Island will help greatly.	Thank you, Bill!
Simply stated The ASHRAE BINS method pretty much predicates that 50% of the heat loss of most structures occurs 97-98% of the total heating hours..Leaving only 2-3% of those hours needed some supplemental heat.	This is statement not a question. Thanks for sharing.
Commercial CO2 heat pumps in Europe can easily reach 180 degrees F	Thank you for that information. I will look into this for inclusion in an upcoming Webinar.
Yes, 140 degree hydronic units are available but these do not meet energy standards for federal credits.	Thank you for that information. I will look into this for inclusion in an upcoming Webinar.
EER geo vs AS systems answers the question	Thank you for that information. I will look into this for inclusion in an upcoming Webinar.
Waiting to see R32	
Dual stage Ammonia based heat pumps can make 180F water.	Thank you for that information.
in the examples with community geo, do you know if rates account for imbalance in heating/cooling load? I am curious how rate structures can be setup to penalize overly imbalanced users.	That is an interesting question. I suppose it would be up to the 'utility' to set up a base rate and have higher rates for those who use excessively; like our tiered rate structure for electricity here in CA. With respect to designing these systems to account for that potential imbalance, there are possilbities of inserting sources or sinks into the system to address that imbalance. Our collective experience is on the design and construction side and is not specific to the owner/developer side; however, we will be bringing some of that discussion into the upcoming Webinars.
Thank you so much for your great presentation. How much it is possible to use ground heat to smooth peak demand? In other words, could it be a secondary tool alongside solar systems to reduce peak demand?	Whether there is a central plant or distributed heat pump system employed for a community heat pump system, there are several ways to provide additional heat source/sinks on the 'source' side of the system. It could be solar as you suggest or it could be additional ground loop to provide the low end of the design range for the source water system.
Is a closed loop geothermal heat exchanger system considered a renewable source? At one time only deep well was consider renewalable?	I think that depends on which State you are in. I know GEO has worked pretty hard to get closed loop geothermal listed as renewable or defined in terms of the local PUCs for access to rebates, incentives, etc.
Any plans for the federal government to assist with funding to install GS distribution grids for communities?	I do not have that information.
In large campuses, e.g. a higher education campus operated by a facilties team, what training effort or best practices in design are there to ensure that the system will be easily operable by facilities staff and not result in issues and breakdowns that cause the facilities team to fall back on a emergency backup boiler or other redundant system instead of the ground source heat pump in order to meet heating and cooling loads?	That is a good question and as an engineer I can certainly make recommendations. Any answer I might provide would be quite lengthy and detailed and is beyond the scope of this Webinar #1.
What temperate interval does the water loop normally work at?	It depends our your local deep earth temperature. The blue book by Kavanaugh and Rafferty recommends 15 deg F below that temperature and 20 deg F above that temperature as a starting point. The final decision is up to the design engineer.
Do you see the CO2 AIr to Water heat pumps becoming main stream for peak shaving in Geo Exchange systems?	Not at this time.
Having never heard of using raw sewage as an energy source before, my initial concern is that there are going to be a lot of issues with blockage caused by ice and debris inherit to sewage, and maintenance is going to be a very frequent, dirty, and dangerous task. How realistic are these concerns or how are they mitigated in practice? In short, what does the sewage/system heat exchanging interface actually look like?	I suggest that you search the internet on *Sewer Heat Exchanger Systems* and several manufacturers will come up. Some are heat exhangers with the pipes (in-pipe) and some are systems that collect sewage, pump it through a heat exchanger, and send it on to the sewer treatment. Also tune in for our Webinar 14 for an example with primary sewage.

NYSERDA has already funded several GSHP and geothermal projects in NYC buildings via MFB programs. Is that experience positive in terms of O&M costs?	This question needs to be directed to NYSERDA. I cannot answer this question
I have a question how many years it takes before it need to replace the heat pump?	ASHRAE has some data on equipment lifetime in their Handbooks. For packaged water-to-air heat pump systems I believe it is 20-25 years. This also depends on the location of the equipment (protected) and maintenance.
One of the biggest impediments to large scale/city community heat pump systems appears to be the installation of distribution piping. With availability of space under the streets at "traditional" depths limited, is there any consideration being given towards horizontal drilling for piping installation below existing utilities? Obviously this would be expensive, but the feasibility of completing a distribution network seems higher and less disruptive to street level activity.	This is a very good question and it will be addressed in an upcoming Webinar.
Do you see a risk of electrical rates and overall utility costs to increase as decarbonization increases?	I cannot answer this question.
Are high temperature heat pumps available in North America market?	See input from other attendees above.
How do you recommend dealing with domestic water heating at DES or at building level?	It is one of the considerations for District Heating Systems and I believe this will be addressed in an upcoming Webinar. I believe Dr. Phetteplace addressed this question during the Q&A.
How much maintenance is required for a sewer heat exchange system?	I suggest contacting one of the manufacturers of these system and asking them directly.
Since most electric power is still produced by burning fossil fuels and 70% of that becomes waste heat, aren't we shooting ourselves in the foot and increasing our carbon footprint by pushing for all electric buildings now?	I cannot answer this question.
If we convert all thermal loads to electric heat pumps, will the electric grid support that? What is the expected increase in percent?	I cannot answer this question.
Are there examples of district chilled water loop operating as a heat pump loop during the winter months when the dedicated cooling loop is idle?	Most DC systems operate in areas that are densely developed and have year round cooling loads. That said, during the off season the central plants normally have much idle capacity so removing heat from the loop is not a problem for the DC service provider. I can envision some very limited circumstances where the DC provider might like to have some heat removed from their supply water to reduce its temperature, but they would be rare.
Community Heat Pump systems create "Natural Monopolies" whose customers no longer have the benefits of a competitive market. Given this, should we regulate Community Heat Pump systems like we currently regulate other natural monopolies like gas, electric, water, etc.?	That is a very good question. I think it depends on the local community and State, but it makes sense based on the way that other utilities are currently regulated.
Did you mention that in Canada, ice making equipment at ice hockey stadiums is often use as a hear source for surrounding buildings... Making ice makes heat!	Yes, Ed Lohrenz has some good examples of this.
Could you shed some light on Geothermal piles? How are they similar or different from GSHPs?	Geothermal piles are essentially building foundation systems with heat exchange pipe integrated within them. They are another way to provide heat exchange with the earth.
Are there any firms that commercially design install and operate (do maintenance if required) these kinda systems?	I am sure there are several but I do not have a short list to provide you at this time. There is little equipment that is unique, so service in general should not be a problem.
What are additional complexities/considerations when it comes to using non-potable water as a part of these systems?	It is not clear if the question is in reference to non-potable water inside the pipe or outside the pipe. Inside the pipe is tricky because the water quality is key to system longevity. I'm not sure if this a something approved by the AHJ but they certainly should be contacted for approval (for example recycled water). For outside the pipe, you might treat non-potable as you would a surface water system using a body of water.
What bout a heat pump chiller that runs HW/CHW inside, and produces potable HW, or sinks excess heat outside? Because if more HW in winter is needed it can be derived from the same smaller loop in the ground, through much larger systems	A heat pump chiller could be employed as suggested; however, the potable water would need to be provided with double-wall heat exchanger for protection.
I see hp chillers becoming like SWUDS McQuay, Trane makes that can be per floor supplied.	Thank you for your input.
https://vip.vanguardhis.comve you heard of the waste heat to electrical peak production equipment by Nova Cab, out of Canada?	Thank you for your input.

Double wall HEX for potable, sink the rest to the smaller ground loop needed.	Yes.
Sectional boilers were oversized with low turn down ratios, but newer condensing boilers	OK.
need to be matched to the load much better than older high temperature return systems. That is why the HP chiller sending the HW/CHW in FCU is a way to zone out space requirements to a very cost-effective system, that has a much larger HP unit supplying the indoor FCU.	Thank you for your input.
do you see a path for solar thermal to assist a project?	I think solar PV and hot water panels are an important path to achieving GHG goals for locations that have good solar advantage.
I have heard ammonia based heat pumps can generate hotter water temperatures - do you have any insight into ammonia based heat pumps?	You are correct. One of the attendees provided some input above. Also, there are many systems in Europe that have central station heat pumps using ammonia supplying hot water at 160 F or more. In Webinar 14 we will talk about some of these.