

Question	Answer
Hi - I am in Ottawa, and hope to find a contractor to do a vertical loop in a small space for a small ground source heat pump. No luck finding a contractor yet. Where can we get help finding a contractor? - Thanks	Hello, thanks for your question! The HRAI has a 'Find a Contractor' tool on their website - you can search and filter for specific professionals (drillers, heat pump installers, etc) based on your location.
	https://portal.hrai.ca/HRAI/Contractor_Locator/HRAI/Contractor_Locator/Contractor_Locator.aspx
I hope that we're going to talk about cost first, as I doubt that I can afford to change my system.	There will be discussion on capital costs but it is a byproduct of home size, property size amongst other potential parameters. There are many people available to help you assess potential costs and benefits
It is my understanding that Heat Pumps require a lot of electricity, how much more does a Heat Pump cost compared to a Gas furnace to provide the same level of heat (if that is even possible).	With the current price of natural gas vs electricity, it would be 10% +/- cheaper to heat your home or building with geothermal. It is absolutely possible
Is a 100amp electrical service adequate for installing a air source heat pump?	Possibly but unlikely. It will depend on the size of heat pump that your home needs and if it requires back up resistance heaters.
Will you be talking about heat pumps useful for gas-fueled heating into large old radiators in an old house?	What you are describing is a water-to-water heat pump in the case of ground source. They are available and installed all the time. A competent contractor with experience should be engaged to see what is possible for your home.

A heat pump depends on having a well insulated house, perhaps far more insulation than the average house has in Canada, how much insulation would be required vis-a-vis what is the current norm in Canada.	The amount of insulation or other building envelope parameters play no factor in your ability to heat with geothermal or ASHP systems. You just have to size your system to heat your home or building. As is the case with any system, the tighter you make your building envelope, the smaller the system you may require to satisfy your heating and cooling systems
Why have I heard energy bills for geothermal heat pumps are in the hundreds each month? Is this common?	If properly sized, designed and installed, a ground source heat pump will be less expensive to run than a gas furnace. High energy bills are caused by systems that are undersized and end up running on back up resistance heaters, which are supposed to be used in emergencies only.
Does the soil type have an influence on the applicability of the ground source solution? For example, my home is located on a sand plain.	The soil conditions can impact the cost of installation as some materials are excavated more easily than others. It's rare to find a location where geothermal is impossible. I'd suggest reaching out to a drilling professional in your area to discuss costs in your location.
How much does it cost to drill down vertically. How far down is required ?	Typically, we are looking to drill down 100 - 200 m. The cost will vary based on the size of loops that are needed for the application.
What is the length of a typical horizontal loop?	Horizontal loops are typically 600ft of 3/4" HDPE pipe/ per ton or 500 ft of 1-1/4" HDPE pipe per ton of capacity required. Typically you would install 1 ton extra of loop compared to equipment size installed. 5 ton heat pump with 6 ton loop, as an example
What is growth in Canada / Ontario for heat pumps ASHP / GSHP	Rapid! There isn't a central database tracking increased uptake in ASHPs/GSHPs so it's hard to put a direct number to it. However, all of us who work in the industry are seeing a significant increase in installations, so it's safe to say the market is growing very quickly.

For the 35% to 45% reduction in CO2 emissions, is this for space heating only, or for whole-home emissions reduction?	That was for heating only but it used marginal emissions factors. A typical gas, propane or oil furnace and hot system with produce 4 - 8 tons of carbon emissions at site/ year. If you switch to a geothermal or ASHP system for space & water heating you can reduce those emissions, at site, to zero!
What is a desuperheater?	A desuperheater is a device for scavenging heat from the heat pump without impairing efficiency, and using it to heat domestic hot water. Think of it as a way of heating your hot water for free.
Gas cost been high due to the Covid and Ukraine debacles, but is now falling dramatically in price. Did you use the recent record high prices in your models? If so how would your models change when gas plummets at the customer level.	Modeling done post-covid and after the start of the war in Ukraine, but with the planned escalations of the federal carbon tax, was still favorable for GSHPs. The rising carbon tax means that gas commodity prices could drop to nearly zero and GSHPs will still be cheaper to operate. This report gives more details on this. https://www.cleanairalliance.org/the-economic-case-for-ground-source-heat-pumps/
1) Are GSHPs efficient for an Ontario cottage that is used 3 seasons out of the year (not in winter).	Yes, a GSHP can be used in a 3 season cottage though you'd likely see a slightly longer payback period since you're not using it all year.
Can a horizontal system be co-installed with a septic system bed WRT to depth, and will it get additional heat from the septic bed?	Some Municipalities do not allow this but your rationale is correct. The ground temperature at 5ft below grade in southern Ontario is a pretty constant 50 deg F or 10 deg C, year round

I have a typical hydronic i.e. Cast Iron Radiator based gas fired system to renew. On a cold day my hot water reaches (and requires) up to 60 deg C (or 140 deg F) to adequately heat this 1905 built building. I am told that this high temperature cannot be reached by GSHP unless I'm on top of a thermal well (like in Iceland). Converting to radiant floor heating is not an option.	You may want to consider changing the heat emitters (radiators -- to a larger size) or using a hybrid system that uses a gas or electric boiler to increase the water temperature when needed.
Drilling professional is different than the installer?	That depends! Sometimes there are companies that only do a portion of the installation (i.e. drilling, loop/pipe installation, heat pump installation), and other companies offer turnkey services.
Heather, what did you assume for natural gas prices? My gas price has increased about 75% in the past two years.	For today's presentation, I used Jan 2023 utility rates. Oct 1 2022 rates were used in the report. Also, if you look into the report, I did an analysis of how low gas prices would have to go before they can compete with GSHPs - it is impossibly low. https://www.cleanairalliance.org/the-economic-case-for-ground-source-heat-pumps/
Do we have to remove our current air conditioning unit outside?	There will be no need for any outside equipment at all, other than the loop in the ground. Many consider that to be a huge benefit. You would no longer need an outdoor AC unit, as everything for your GSHP is either in your basement or the loop buried under ground.
Is this system using net metering with the grid?	A geothermal system isn't feeding electricity back to the grid. It is using electricity from the grid to run a pump and compressor to move energy from the ground to the inside, at a ratio of 1:3.5-5.0

I'm in area where -30 C is common and -40 is not unusual - in this case is a hybrid unit (natural gas + GSHP) a better choice?	There is a lot of experience installing GSHPs in areas that regularly experience extreme temperatures. The goal is first to reduce the heating load of the home by ensuring it is properly insulated and air sealed so that the heat pump is able to match the load. An experienced geothermal contractor should be consulted for system design considerations.
I am planning to drill a well on my rural property. Can the loop be combined in some way with the well?	Yes, this is called an open or well loop and is quite common. Permitting of the well loop will be based on local regulations.
What effect does taking heat from the ground have on the soil and microorganisms?	Since GSHPs both heat and cool buildings (and we have both hot summers and cold winters here in Canada/Ontario), a well designed and operated system should not cause significant changes to ground temperature.
Are lake loops practical in Ontario and similar climates? Do you need to use closed loop systems for lakes?	Lake loops or closed loops and are common, but are permitted by the locality - some don't like them.
Can heat pumps be connected to in-floor heating systems?	Yes. Water-to-water ground source heat pumps are available and can be connected to in-floor heating systems.
We have a GSHP that was installed 21 years ago. Is there any value to doing any upgrades or updates to the system? If so what would you suggest?	It would absolutely be very beneficial to switch to a more efficient/ modern geothermal heat pump. Through Greener Homes/ Enbridge Program you would also be eligible for a \$3,000 rebate to switch over to a new more efficient unit
During winter does any part of the GSHP system need to be drained? I drain the entire Cottage water system for winter.	No. An anti-freeze solution is added to the ground source loop to prevent it from freezing.

So this needs a 3000ft/1km of pipe? coiled? So what area square m of ground are needed?	for a system that requires 3000 ft of pipe you would need 3 trenches 5ft wide X 5ft deep X 300 feet long, or an area of 25ft X 300 ft
I live in Thunder Bay. This morning it was -30°C plus Wind Chill. Where I live is not far above the Precambrian shield. How practical is a Heat Pump here? At what cost?	Efficiency of a GSHP would not be significantly impacted by the outdoor temperature (for all the reasons Jeff mentioned), so it would definitely be technically feasible. A vertical system can be drilled into the shield relatively easily, but of course, finding a contractor in Thunder Bay may be challenging. Drilling in hard rock like shield is also typically more expensive compared to softer rocks like shale, but there is still likely a strong payback period.
For a backyard, 12 meters by 20 meters, assuming no large rocks, or plant roots, would you be able to do a horizontal loop system, or would it have to be vertical.	Vertical loop would be required
in general what outside temperature do you use to size the GSHP system - a winter temp or a summer temp - considering Ontario temperatures	Systems are sized based on the winter design temperature for the locality the system is being installed in.
You seem to be mostly speaking about houses. Is it possible and economical to put in this in an older (1976) 18 floor condo building?	Geothermal for MURBs is becoming quite popular - you might have seen the story on the front page of the National Post Homes section last Saturday. Those systems typically use in-suite water-to-air heat pumps. An engineer or contractor with this kind of experience should be engaged to answer questions of what is possible for your application.
Is there a rough Rule of Thumb to estimate the linear amount of ground loop needed per square foot of living space (of new, high	There is never a good case for "rule of thumb" stances but with residential new construction using a high level 20 btus/ hr per ft ² of space. Having a qualified person do a heat loss/ heat gain analysis is highly recommended

efficiency residential construction)?	
Are there any real life examples in the GTA of people who upgraded their electrical to 200 amps, did a 600 foot drill (or maybe two if house is larger), installed a heat pump system, have a backup system installed, and have a few years of running costs and installation costs for review?	Yes. there are many examples available. See https://www.cleanairalliance.org/heat-pump-testimonials/ to start.
And what temperature is that? Like 100% of coldest day, or a %, plus accounting for the envelope of the home?	Usually, it is the 99% design temperature. The heat loss calculation is done according to CSA F280.
How deep does a vertical loop go?	Many drillers *can* go to about 850' deep, but you likely won't need holes that deep for a single home (more commonly 200-500ft).
What is a typical cost for the installation of a typical heat pump in a typical 3000 sq. ft. home that is recently built?	We modelled an upfront cost of \$27,000 for a 3t horizontal system and \$32,000 for a 3t vertical system
What is the best type of soil?	Saturated soil of any kind is ideal. the wetter, the better!
what's the typical back up system for power outages?	Keep in mind that most homes have no backup system for power outages (even a gas furnace won't operate if the power is out). Backup power for a GSHP wouldn't be any different than for any other electrical application.

Would or could a ground source heat pump work with a sand battery for heat storage for water heating for household water needs? https://polarnightenergy.fi/sand-battery	I'm not sure I understand what a sand battery is, but a GSHP can work with really any heat source/sink.
Who would I contact to gets stats on the real life examples?	I recommend that you look for a contractor on the HRAI member locator. Select Heat Pump - Ground Source https://portal.hrai.ca/HRAI/Contractor_Locator/HRAI/Contractor_Locator/Contractor_Locator.aspx Also see: https://www.cleanairalliance.org/heat-pump-testimonials/
Do I need approvals/permits from the City of Toronto to install a vertical loop ground source heat pump?	Typically; yes. It is not an onerous process with the proper people involved
Can heating a pool be tied into the system?	Definitely possible - a conversation with an installer in your area would be super helpful as they could give you a more detailed look at cost/what you'd need to make that happen.
At what depth usually is the horizontal line and how many feet for a 800 sq.ft. home	The loop must be below the frost line. That is typically a depth of around 6'. The number of linear feet will depend on the calculated load. The square footage of the home is only one variable in that calculation.
Can we have both an air heat pump and ground heat pump in the same house?	Yes, but I don't know why you would.
What about the part of the loop that comes into the basement? Is there a risk of that freezing in winter? Or would the water in the loop keep running year round?	There is usually some level of freeze protection in the loops. Often times, food grade propylene glycol or ethanol is used to prevent freezing in the pipes.

Can a GSHP be installed on a slope?	Yes. topography or elevation changes have no adverse effect on loop performance whatsoever.
Are there Canadian made heat pumps?	Yes there are
What is the minimum property size for a horizontal system?	This would depend on the size/type of building you're looking to heat and cool.
What is the minimum/ average cost for an single family residential home?	Heather's report modelled an upfront cost of \$27,000 for a 3t horizontal system and \$32,000 for a 3t vertical system. https://www.cleanairalliance.org/the-economic-case-for-ground-source-heat-pumps/
The fluid circulating through the underground loop has been described as being water. If so, how far into the house must the piping come before coming up? (my house is slab on grade). I once tried to get a price on a geo thermal system and the contractor really did not want to do it because of the difficulty of this type of a retrofit	The fluid is water with a glycol antifreeze. Systems are challenging to retrofit in urban areas. Check the contractor locator from HRAI to see if there is someone in your area that has experience with your type of application. https://portal.hrai.ca/HRAI/Contractor_Locator/HRAI/Contractor_Locator/Contractor_Locator.aspx
Does it make sense economically and environmentally for a whole Urban (ie. East York) Toronto block to work together to install a horizontal heat soruce for the whole block to replace our gas furnaces and air conditioners (assuming we can get all 30 or so households to agree)?	See the webinar recording for a discussion of this idea and why it does not result in economies of scale. Coordinating individual installations among neighbours may be more economic and efficient.
How close can the pipes be to each other in a vertical groundsource systems or are there 2 holes required to be drilled ?	Answered in recording. At least five feet apart.

Are there hybrid GSHP systems augmented with gas fired hydronic systems that can reach the high 40 deg C water temps required for my existing cast iron radiators?	Yes, you can use a gas boiler as back up for a water-to-water system.
What's the "t" in \$27,000 for a 3t horizontal system	that is a 3tonne system, or 36000 BTU/hr. Keep in mind that gas furnaces are typically oversized. We had a 60,000 BTU/hr mid efficiency furnace that was replaced with a 3t heat pump. A home energy audit can tell you what size heat pump you need.
Can a horizontal system be installed in the front yard?	That depends how big a front yard you have. If you are on an acre of land with a large front yard, it is possible.
Are there any places where a church lawn is used as a base for district heating and cooling?	For district energy, not that I know of. But there have been a number of churches in Ontario that have had GSHPs installed to service their own heating and cooling. See the recording for a discussion of why small scale district heating may be less efficient.
Once the pipe is in the ground, can it be damaged by heavy loads on top of it (i.e. heavy machinery, tractors, etc)	You can drive over this pipe without damaging it typically.
In an Ottawa suburb could two neighbours pair up for installing a ground source heat pump (i.e., could one hole serve the heating-cooling needs of two 1500 sq. ft. homes?	Probably not one single hole. Drilling depth in Ottawa can be limited due to the granite bedrock. You're likely better off each installing your own boreholes (would likely make it easier to sell the homes in the future as well) - you'd save money by having one 'mobilization' fee from the driller if you get them done at the same time.
How does the ground temperature get 'boosted' to a comfortable in-house temperature with a GSHP?	That is the magic of the refrigeration cycle. It can concentrate the heat energy so that the air going into your home is 21'C even if the loop temperature is much lower.