



GROUND SOURCE

Your Boone Electric guide to Ground Source Systems

For more information about Ground Source Heat Pumps, call the Member Services Department at 573-449-4181 or visit our website at BooneElectric.coop.



Boone Electric Cooperative

March 2024

Ground Source Heat Pumps: What are they and how do they work?

**You're Standing on
the Most Efficient
Heating System.**



The Earth!

**So Dig a Little Deeper
- Install a Ground
Source Heat Pump!**

A ground source heat pump is an electronically powered device that uses the natural heat storage ability of the earth to heat and cool your home or business.

Like any type of heat pump, it simply moves heat energy from one place to another. The earth has the ability to absorb and store heat energy. To use that stored energy, heat is extracted from the earth through an anti-freeze solution and is circulated to the heat pump. There, the heat is used to heat your home. In the summer, the process is reversed and indoor heat is extracted from your home and transferred to the earth through the anti-freeze solution.

QUESTIONS MOST OFTEN ASKED ABOUT GROUND SOURCE HEAT PUMPS

Q: What makes a unit an Energy Star-rated unit?

A: All Ground Source Heat Pump (GSHP) systems must be rated as Energy Star units to qualify for Boone Electric's rebates. Only systems tested and rated by American Refrigeration Institute (ARI) as Energy Star are considered Energy Star units. For more information go to www.ceedirectory.org.

Q: Why haven't I heard more about ground source systems?

A: The technology has been known for about 40 years; however, gas, oil and electricity were so cheap in the past, people did not look for alternative sources of heat.

Q: Can I still use my existing furnace duct work?

A: In most cases, duct work installed with existing gas and oil furnaces should be adequate. Duct work installed with gravity flow furnaces will probably need to be extensively revamped. The existing duct work must be of proper capacity to allow a minimum of 400 CFM per ton air movement with minimum velocity. If ducts are too small, efficiency will drop and noise levels will rise. Duct work in unconditioned areas will need to be insulated.

Q: What is the expected compressor life with a ground source heat pump?

A: According to most manufacturers, since it is located indoors and has no defrost cycle, compressor life should be 17-plus years - similar to an electric freezer or refrigerator.

Q: Will I need to add anti-freeze to my loop water?

A: Yes. A 20% to 30% solution of food grade polypropylene glycol or methanol is recommended.

Q: Do I need a back-up heating system?

A: Not for normal operation. Only if there are equipment failures. When installed in an energy-efficient structure and the heating unit is properly sized according to Manual J calculations, with a design temperature of 80 degrees, no supplemental heat is required.

Q: Can a large, buried tank or cistern be used to rapidly warm ground water to its original temperature?

A: There is not enough mass or water-to-soil heat transfer surface to allow an operation similar to a closed loop.

Q: What is a compressor de-superheater?

A: It is a device that reclaims heat normally lost when a heat pump or air conditioner compressor operates in the cooling mode. Heat is also generated during the heating mode, but normally becomes part of the normal heat output of the unit.

Q: What is a good means to achieve an R-10 with a basement wall?

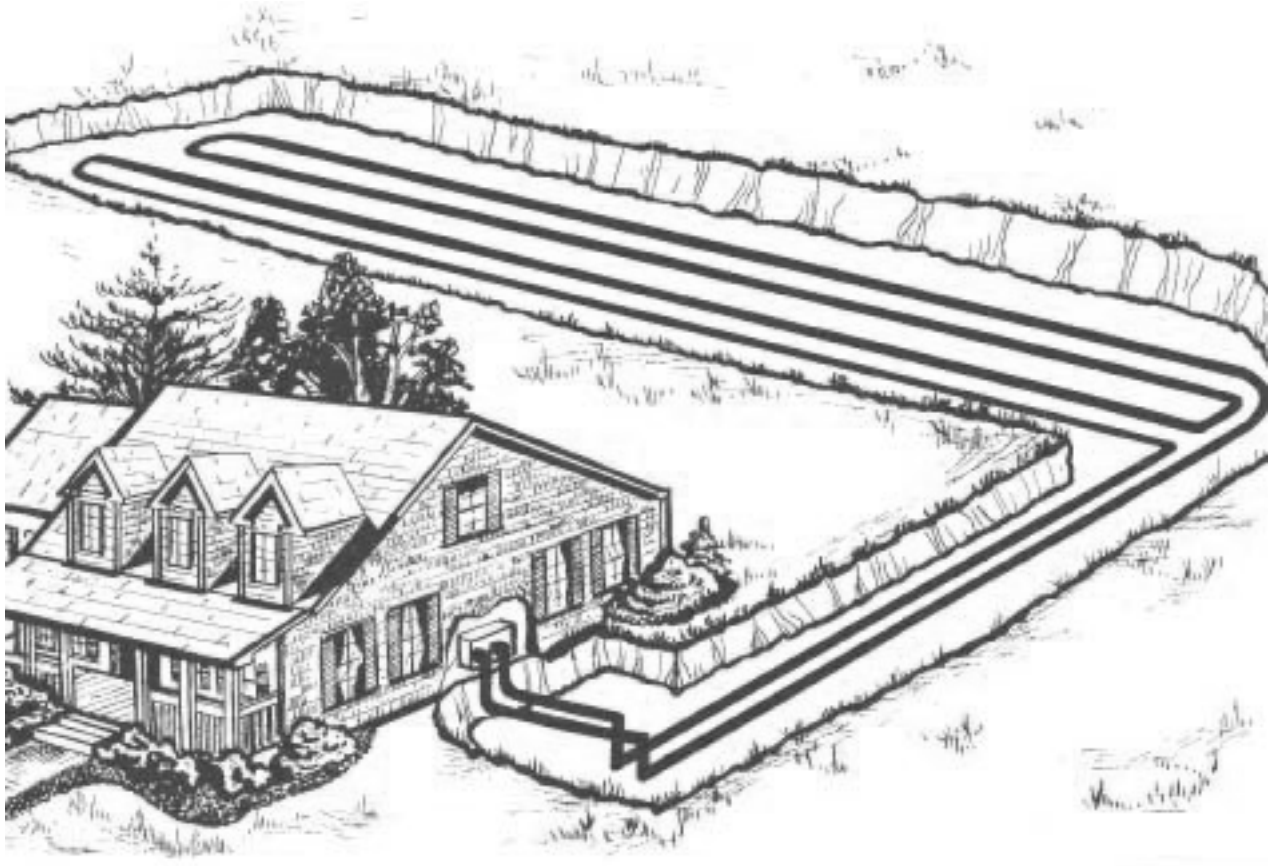
A: The best means is by placing 2" of Dow blue board or equivalent on the outside of the concrete basement wall during construction. The use of fiberglass insulation and a continuous vapor barrier with a stud wall next to the concrete wall may be the best option with an existing house if the blue board cannot be retrofitted.

Q: Can backup heat be installed?

A: Backup electric heat can be installed, provided it meets Boone Electric specifications. These are, but not limited to:

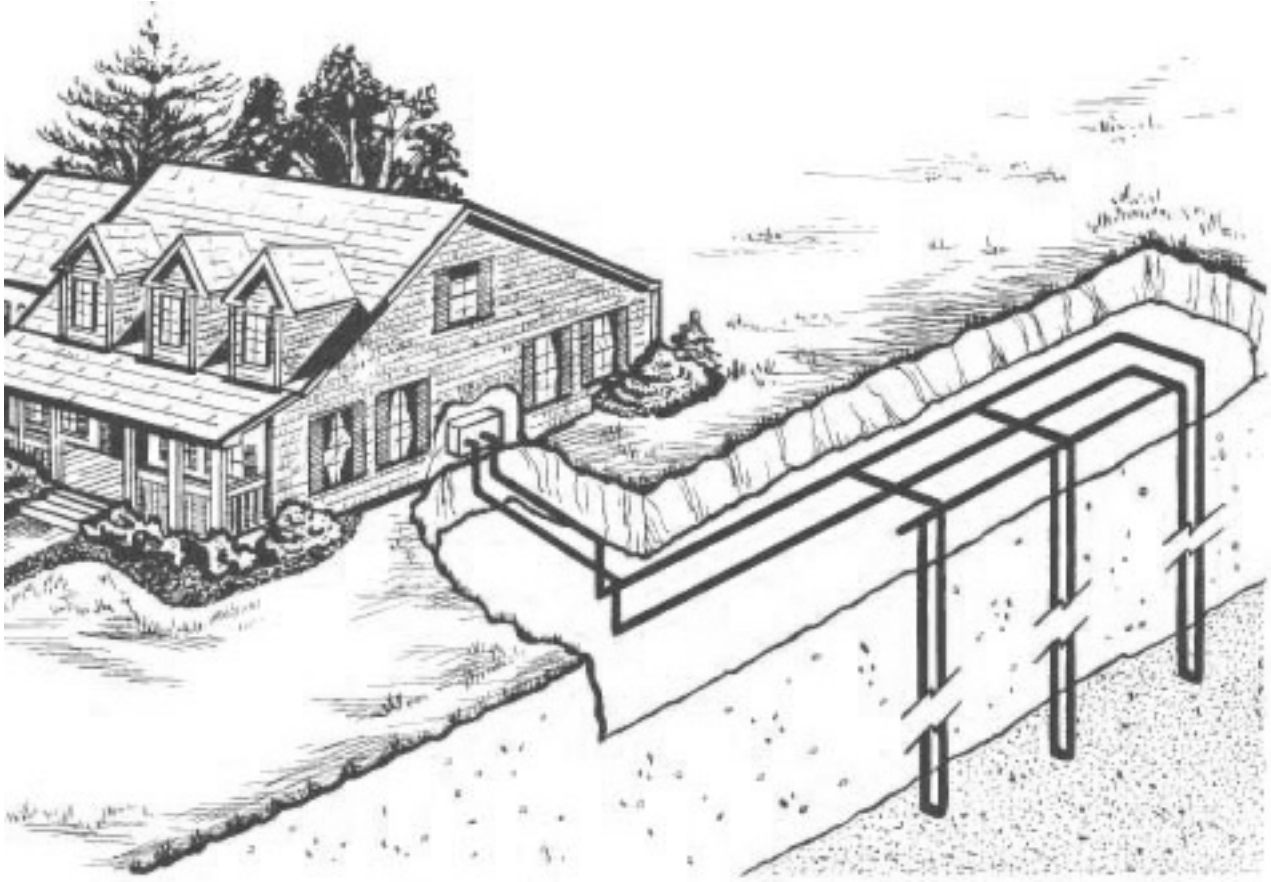
1. All backup heat may be separately metered.
2. Any backup heat must be interruptible via a load control switch.
3. Any backup heat cannot be configured as 2nd stage or 3rd state - emergency use only.
4. Backup heat must be on a separate switch that must be manually closed before the backup heat can operate

Two-Pipe Horizontal Ground Heat Exchanger



Earth Coil Type:	Horizontal Two-Layer
Water Flow:	Parallel
Typical Pipe Size:	3/4-inch loops, 1 1/4-inch header
Practical Length:	250 feet of trench/ton 500 feet of pipe/ton <i>*Follow manufacture specifications on feet of pipe/ton</i>
Burial Depth:	6 feet. The deeper, the more consistent the ground temperature.

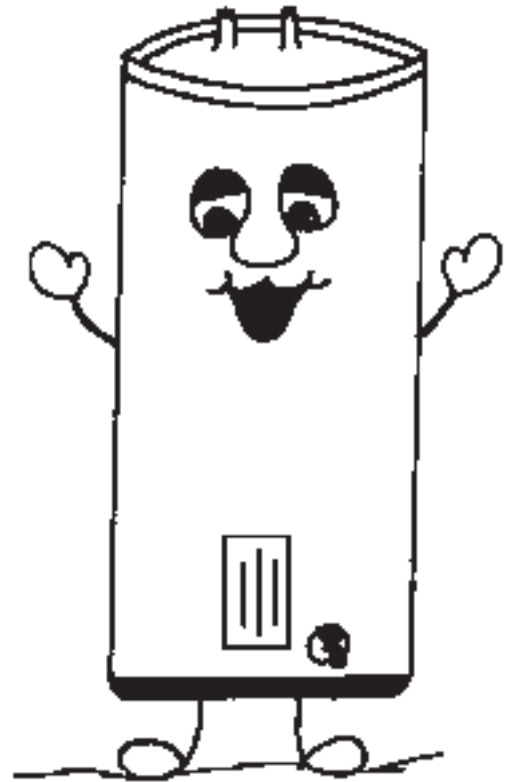
Parallel Vertical Ground Heat Exchanger



Earth Coil Type:	Vertical - Single U-Bend
Water Flow:	Parallel
Typical Pipe Size:	3/4- or 1-inch loops, 1 1/2- or 2-inch headers
Bore Lengths:	175 to 225 feet/ton
Pipe Lengths:	350 to 450 feet/ton
	<i>*Follow manufacture specifications on feet of pipe/ton</i>

Water Heater Savings Too!

For residential
usage, 60-70%
of your domestic
hot water is
heated free!



Primarily in summer, during air conditioning.

COST OF 1 MILLION BTU's OF HEAT FROM VARIOUS FUELS

TYPE OF ENERGY	UNIT	AVG. COST	AVG. FURNACE EFFICIENCY	ADJ. COST 1,000,000 BTU's
ELECTRICITY Dual Fuel Rate (Regular Rate)	KWH	\$.061 Per KWH (\$.095 Per KWH)	250% (COP2.5) SEER 13, 3 TON	\$7.14 (\$11.13)
GROUND SOURCE HEAT PUMP Regular Rate	KWH	\$.095 Per KWH	350% (EER 12.0)	\$7.95
NATURAL GAS	Therm or CCF	\$1.00 Per CCF	65% 85%	\$14.65 \$11.20
NO. 2 FUEL OIL	Gallon	\$3.60 Per Gallon	62.5%	\$41.14
WOOD (STOVE) Dry Oak	Cord	\$125 Per Cord	50%	\$10.87
PROPANE	Gallon	\$1.50/\$2.00/\$2.50 Per Gallon	65% 85%	\$25.64/\$34.19/\$42.73 \$19.61/\$26.14/\$32.68
KEROSENE	Gallon	\$4.26 Gallon	80%	\$39.44
ELECTRICITY Regular Rate	KWH	\$.095 Per KWH	100%	\$27.83
WOOD (FIRE PLACE) Dry Oak	Cord	\$125 Per Cord	5%	\$108.70

Formula: $\frac{\text{Heating Value} \times \text{Efficiency of System}}{1,000,000} \times \text{Cost of Fuel} = \text{Cost of Delivered Heat for 1,000,000 BTU's}$

Heating Values of Various Fuels

Fuel	Unit	Heating Value
Natural Gas	Btu/ft ³	1,050
Propane	Btu/gallon	90,000
No. 2 Fuel Oil	Btu/gallon	140,000
Wood (white oak)	Cord	23,000,000 Btu
Kerosene	Btu/gallon	135,000
Electric	KWH	3,413

BOONE ELECTRIC'S GROUND SOURCE HEAT PUMP PROGRAM

Boone Electric's Ground Source Heat Pump Program is available to members only when the system is installed by a dealer who has received training according to Boone Electric's requirements. Boone Electric will not recommend a specific dealer. It is up to the member to select the dealer best suited for the installation.

BOONE ELECTRIC PROVIDES:

1. Rebates of \$250/ton of installed capacity applied to loop cost. An additional rebate of \$500/ton is being made available to co-op members by Boone Electric's power supplier and only for a limited time. The installation must meet all of Boone Electric's requirements to qualify. (Rebate amount may change, and all rebates are subject to federal and state tax.) Residential rebates have a 10-ton limit and commercial rebates have a 50-ton limit.
 - a. A \$150/ton rebate is also available for a limited time to Boone Electric members who replace an existing GSHP system with a minimum 19.1 EER rated system that also meets all installation requirements (geothermal heat pump criteria and is at least a 3 EER improvement over existing system).
2. A load management device may be installed on an electric resistance heat that has been installed as an emergency backup heat on the GSHP. Control of emergency resistance heat is at Boone Electric's discretion. **Boone Electric also reserves the right to sub-meter either the GSHP or any emergency heat.**
3. On a preexisting home, a Home Performance Energy Star audit and blower door test will be required before sizing of equipment to determine insulation values on retrofits and fitness of structure for program according to Manual J calculations and Boone Electric's design criteria on existing homes.
4. Boone Electric will review its Dealer List on an annual basis to analyze individual dealers' past involvement for future standing in the program, as well as DNR eligibility.

The house must be an energy-efficient structure.

Minimum insulation requirements as determined by Boone Electric:

Insulation Levels:	Recommended Levels:
Attics: R-45	R-50
Walls: R-13	R-19
Basement or crawl space wall: R-11 and/or Floors: R-13	R-19

Duct Work: All duct work that runs through an unconditioned space must be insulated (R-13). All duct work must be properly sealed to prevent air leakage. Main HVAC unit needs to be in a conditioned area.

Doors: Urethane core: R-13.5
Polystyrene core: R-7.5
Solid wood with storm: R-3.5

Attic Ventilation:

Ratio of total net free area to area of ceiling shall not be less than 1/150, except ratio may be 1/300 provided:

- A vapor barrier having a transmission rate not exceeding one perm is installed on the warm side of the ceiling; or
- At least 50% of the required ventilating area is provided by ventilation located in the upper portion of the space to be ventilated (at least 3 feet above eaves or cornice vents), with the balance of the required ventilation provided by eaves or cornice vents.

Windows: Double pane insulated: R-2 or R-3
Single pane with storm windows: R-1.9

MEMBER PROVIDES:

1. Do follow up yard work to level ground.
2. Identify U.G. services; i.e. cable, telephone, water, etc. If damaged because of improper location, repair will be the responsibility of the member.
3. Member agrees to not install or operate any form of back-up heat, electric or other wise, without expressed written consent of Boone Electric Cooperative. Failure to comply will result in the repayment of all rebates paid to member. If electric base board heating is pre-existing, it must be permanently disconnected so it cannot be used.
4. Member agrees to not tamper with any of the equipment on the unit(s) or back-up heating systems.
5. No rebates will be forwarded to the member until all required paperwork/calculations are provided to Boone Electric and all minimum standards are met with regard to building infiltration and insulation.

CONTRACTOR PROVIDES:

1. **No electric resistant backup or emergency heat allowed** unless installed according to Boone Electric specifications. Any electric strip heat is for emergency situations only and heat must be disconnected in furnace by wiring or low voltage connection. No physical electrical connection to strip heating is allowed. Wire nutting off of wire in unit may be allowed. Wi-Fi thermostat systems must be configured to not have electric strip heat to come on in second stage or emergency at all.
2. Manual J heat calculations, new or retrofit. A Manual J calculation must be presented to Boone electric before a rebate will be paid. Heating design is not to exceed cooling load by more than 200% with single speed compressor. Unit to be capable of delivering required BTU's at **45 degrees entering water temperature** with a unit design of **80 degrees Delta T**.
3. All systems must be a minimum 19.1 EER rating. The dealer must verify the system, the EER rating, and supply the ARI reference number on the rebate form.
4. Installation of system according to NRECA/OSU/IGSHPA Closed-Loop/Ground Source Heat Pump Installation Guide or revised application procedures according to IGSHPA and manufacturer's requirements. Type of loops, pipe type, and total footage of pipe **will need to be provided**.
5. Provide professional quality service and provide customer warranty for one year minimum on parts and labor.
6. Assure duct work provides 400 CFM/Ton capacity and both supply and return are insulated if it runs through an unconditioned space. The duct work must be adequately sealed to prevent leaks.
7. Remain certified and be in good standing with Missouri DNR, as required by law.

** The dealer agrees that on the first three units installed, the dealer will work with a factory representative on the installation of the ground source heat pump to gain on-the-job training.

Take Control & Save[®]

Ground Source Heat Pump Requirements

1. Manual J calculations using a local design temperature with an 80° Delta T and output of the system to match the required BTU's with 45 degree EWT.
2. No electric-backup heat hooked up in unit or designed into second or third stage.
3. Copy of PAID receipt from HVAC dealer.
4. Loop information with name and contact information of loop installer:
 - Horizontal - total footage, pipe diameter and depth
 - OR
 - Vertical - number of wells, pipe diameter and depth.
5. Take Control & Save forms (completed by both dealer and member) and copy of ARI Certification (completed by dealer). Rebates (\$750/ton) require a minimum EER 19.1 (check for current qualification).

Ground Source Heat Pump Dealers

Accurate Heating & Cooling	Columbia.....	442-7312
Air & Water Solutions	Columbia.....	445-1112
Aire Serv Heating & Air Conditioning.....	Jefferson City	636-4490
.....	Columbia.....	256-4490
Albright Heating & Air Conditioning.....	Columbia.....	875-7888
American Geothermal.....	Columbia.....	825-3350
Bentlage Heating & Cooling	Hartsburg.....	657-8515
Bodine & Feger Heating & Air Conditioning	Mexico	(573) 253-0929
Burks Service Company	Columbia.....	874-1501
Chapman Heating & Air Conditioning.....	Columbia.....	445-4489
Cockrum Service	Columbia.....	445-7098
Comfort Crew Heating & Cooling	Columbia.....	(573) 355-1494
Hancock Refrigeration & Heating.....	Centralia.....	682-3805
Hilgedick Electric Service	Fayette.....	(660) 248-3151
Lasater Heating & Cooling.....	Ashland	808-0574
O2 Geothermal	Columbia.....	442-7042
Perfectionaire Heating & Cooling.....	Moberly.....	(660) 263-2292
Peters Heating & A/C	Columbia.....	443-3660
Reed Heating & Air Conditioning.....	Columbia.....	445-4112
Rehagen's Heating & Air Conditioning.....	Westphalia.....	(573) 455-2394
Schnell Drilling.....	Rocheport.....	(573) 698-2050
Senter's Heating & Cooling.....	Centertown.....	(573) 636-5081
Show-Me Heating & Air Conditioning	Ashland	(573) 289-8885
Smith Heating & Cooling.....	Columbia.....	814-0506
.....	Moberly.....	(660) 263-5944
Star Heating & Air Conditioning.....	Columbia.....	449-3784
Vaughn Heating & Cooling.....	Columbia.....	239-3611

All GSHP dealers, as required by law, must be certified by the Department of Natural Resources or be operating under a certified contractor to install certain outdoor loop configurations. Contact Boone Electric for more details.