

# A Survey for Ground Heat Exchanger Installation

(4/26/2017)

Oak Ridge National Lab (ORNL) is working on a research project to understand the current state-of-the-art of ground heat exchanger installation, including methods, installation technologies, and needed equipment and materials. The goal of this study is to identify technology improvements needed to facilitate wider adoption of ground source heat pump systems in both the commercial and residential sectors. This survey is a part of the project and it is to collect information of the typical installation process and associated cost. We will keep your answers to this survey confidential and only report general information (such as the average cost breakdown of a ground heat exchanger in a region) in our study. Please take a few moments to complete and return this survey. Your input is vital to the success of this project and will be greatly appreciated.

## Section 1. Information about you and your company

1. How many years have you been involved with Ground Source Heat Pumps?  
 2 years or less.  3-5 years.  6 to 10 years.  Over 10 years.
  
2. Which of the following best describes your company type:  
 Electric Cooperative.  Electric G&T.  HVAC Contractor.  Loop Contractor.  
 Loop and HVAC Contractor.  Other (Specify) \_\_\_\_\_
  
3. What is your title and/or job description?  
\_\_\_\_\_
  
4. What states does your company serve? \_\_\_\_\_
  
5. How many ground source heat pumps (in cooling tons) has your company installed during the last two years? \_\_\_\_\_

## Section 2. Information about ground loop

6. Please indicate the percentage of loop systems you typically install:
  - a. Straight horizontal?  Less than 10%  10-25%  26-50%  51-75%  76-100%  None
  - b. Horizontal-slinky?  Less than 10%  10-25%  26-50%  51-75%  76-100%  None

- c. Vertical?            \_\_\_ Less than 10%   \_\_\_ 10-25%   \_\_\_ 26-50%   \_\_\_ 51-75%   \_\_\_ 76-100%   \_\_\_ None
- d. Other? \_\_\_\_\_   \_\_\_ Less than 10%   \_\_\_ 10-25%   \_\_\_ 26-50%   \_\_\_ 51-75%   \_\_\_ 76-100%   \_\_\_ None

7. What is the average cost per ton for each type of ground loop (direct cost only)?

Cost to Install Loop (per ton)

- Straight horizontal            \$ \_\_\_\_\_ per ton
- Horizontal - Slinky            \$ \_\_\_\_\_ per ton
- Vertical                            \$ \_\_\_\_\_ per ton
- Other \_\_\_\_\_                \$ \_\_\_\_\_ per ton

8. Please indicate the percentage of following ground loop piping materials you have installed within the last two years:

- a. High Density Polyethylene (HDPE)?   \_\_\_ Less than 25%.   \_\_\_ 25-50%.   \_\_\_ 50-75%.   \_\_\_ 75-100%   \_\_\_ None
- b. Crosslinked polyethylene (PEX)?   \_\_\_ Less than 25%.   \_\_\_ 25-50%.   \_\_\_ 50-75%.   \_\_\_ 75-100%   \_\_\_ None
- c. Polybutylene (PB)?   \_\_\_ Less than 25%.   \_\_\_ 25-50%.   \_\_\_ 50-75%.   \_\_\_ 75-100%   \_\_\_ None
- d. Copper?   \_\_\_ Less than 25%.   \_\_\_ 25-50%.   \_\_\_ 50-75%.   \_\_\_ 75-100%   \_\_\_ None
- e. PVC?   \_\_\_ Less than 25%.   \_\_\_ 25-50%.   \_\_\_ 50-75%.   \_\_\_ 75-100%   \_\_\_ None
- e. Other \_\_\_\_\_?   \_\_\_ Less than 25%.   \_\_\_ 25-50%.   \_\_\_ 50-75%.   \_\_\_ 75-100%   \_\_\_ None

9. Please indicate the percentage of following types of ground loop you have installed within the last two years:

- a. Single U-tube?   \_\_\_ Less than 10%.   \_\_\_ 10-25%.   \_\_\_ 25-50%.   \_\_\_ 50-75%.   \_\_\_ 75-100%   \_\_\_ None
- b. Double U-tube?   \_\_\_ Less than 10%.   \_\_\_ 10-25%.   \_\_\_ 25-50%.   \_\_\_ 50-75%.   \_\_\_ 75-100%   \_\_\_ None
- c. Co-axial?   \_\_\_ Less than 10%.   \_\_\_ 10-25%.   \_\_\_ 25-50%.   \_\_\_ 50-75%.   \_\_\_ 75-100%   \_\_\_ None
- d. DX?   \_\_\_ Less than 10%.   \_\_\_ 10-25%.   \_\_\_ 25-50%.   \_\_\_ 50-75%.   \_\_\_ 75-100%   \_\_\_ None
- e. Other \_\_\_\_\_?   \_\_\_ Less than 10%.   \_\_\_ 10-25%.   \_\_\_ 25-50%.   \_\_\_ 50-75%.   \_\_\_ 75-100%   \_\_\_ None

10. What is the approximate cost per foot of ground loop piping material? Please indicate the piping material in your answers.

- 3/4"?   \$ \_\_\_\_\_                            1-1/4"?   \$ \_\_\_\_\_
- 1"?   \$ \_\_\_\_\_                                1-1/2"?   \$ \_\_\_\_\_

11. What is the average length for the following:

Vertical borehole? \_\_\_\_\_ ft.

horizontal trench? \_\_\_\_\_ ft.

Other \_\_\_\_\_? \_\_\_\_\_ ft.

12. What is the approximate cost per foot of horizontal header piping?

1"? \$ \_\_\_\_\_ 1-1/2"? \$ \_\_\_\_\_

1-1/4"? \$ \_\_\_\_\_ 2"? \$ \_\_\_\_\_

13. Please detail the following information for boreholes and trenches:

How many feet trenches do you dig in a working day on average? \_\_\_\_\_

What is the approximate price of digging a trench per foot? \$ \_\_\_\_\_

How many feet vertical boreholes do you drill in a working day on average? \_\_\_\_\_

What is the average borehole depth? \_\_\_\_\_ ft.

What is the average borehole diameter? \_\_\_\_\_ in.

What is the average rate of penetration? \_\_\_\_\_ ft./hr.

What is the approximate price of drilling a borehole per foot? \$ \_\_\_\_\_

### Section 3. Information about drilling and grouting

14. Please indicate the percentage of drilling rigs used for the past two years:

A. Cable Tool

\_\_\_ Less than 10% of the time. \_\_\_ 10 - 25% of the time. \_\_\_ 25 - 50% of the time.

\_\_\_ 50 - 75% of the time. \_\_\_ 75 - 100% of the time. \_\_\_ None of the time.

B. Mud Rotary

\_\_\_ Less than 10% of the time. \_\_\_ 10 - 25% of the time. \_\_\_ 25 - 50% of the time.

\_\_\_ 50 - 75% of the time. \_\_\_ 75 - 100% of the time. \_\_\_ None of the time.

C. Reverse Rotary

\_\_\_ Less than 10% of the time. \_\_\_ 10 - 25% of the time. \_\_\_ 25 - 50% of the time.

\_\_\_ 50 - 75% of the time. \_\_\_ 75 - 100% of the time. \_\_\_ None of the time.

D. Air Rotary

\_\_\_ Less than 10% of the time. \_\_\_ 10 - 25% of the time. \_\_\_ 25 - 50% of the time.  
\_\_\_ 50 - 75% of the time. \_\_\_ 75 - 100% of the time. \_\_\_ None of the time.

E. Downhole Hammer

\_\_\_ Less than 10% of the time. \_\_\_ 10 - 25% of the time. \_\_\_ 25 - 50% of the time.  
\_\_\_ 50 - 75% of the time. \_\_\_ 75 - 100% of the time. \_\_\_ None of the time.

15. What type of drill bits has your company typically used to drill boreholes? \_\_\_\_\_

16. What are the sizes and approximate cost of the drill bits most commonly used?

<u>Size</u>	<u>Cost</u>
___ in	\$ _____
___ in	\$ _____
___ in	\$ _____

17. What is the life span of the drill bit? \_\_\_\_\_ ft.

18. Do you own or rent the equipment needed? \_\_\_ Own \_\_\_ Rent.

(IF Own) What are the approximate costs for using the equipment?

- Rig \_\_\_\_\_ \$/hr.
- Air Compressor \_\_\_\_\_ \$/hr.
- Water Truck \_\_\_\_\_ \$/hr.
- Grout Machine \_\_\_\_\_ \$/hr.
- Backhoe \_\_\_\_\_ \$/hr.
- Other \_\_\_\_\_ \$/hr.

(IF Rent) What are the approximate rental costs for using the equipment?

- Rig \_\_\_\_\_ \$/hr.
- Air Compressor \_\_\_\_\_ \$/hr.
- Water Truck \_\_\_\_\_ \$/hr.
- Grout Machine \_\_\_\_\_ \$/hr.

Backhoe \_\_\_\_\_ \$/hr.

Other \_\_\_\_\_ \$/hr

19. What is the approximate cost to move the rig? \$ \_\_\_\_\_

20. What is the approximate cost for fuel per rig and for horizontal trenching and fusion? \$ \_\_\_\_\_

21. What is the approximate cost for labor? \$ \_\_\_\_\_

22. How many people, on average, are onsite to help with installation (per rig)? \_\_\_\_\_

23. What are the approximate costs for the drill mud and grouting per borehole?

Drill Mud \$ \_\_\_\_\_

Drill Mud Additives \$ \_\_\_\_\_

Grout \$ \_\_\_\_\_

Tremie Pipe for Grouting Borehole \$ \_\_\_\_\_

Water \$ \_\_\_\_\_

24. What type of grout do you use on average? \_\_\_\_\_

25. What type of mud do you use on average? \_\_\_\_\_

26. Please detail the types of geological formations you encounter during drilling (sand, limestone, shale, etc.) and rough percentages

\_\_\_\_\_

27. Do you charge varying rates for drilling boreholes in different geological formations? \_\_\_\_ Yes. \_\_\_\_ No.

(IF YES) Please indicate two or three of the most common geological formations and the cost of drilling:

Geological Formation      Cost per Foot

1. \_\_\_\_\_ \$ \_\_\_\_\_

2. \_\_\_\_\_ \$ \_\_\_\_\_

3. \_\_\_\_\_ \$ \_\_\_\_\_

**Section 4. Information about other costs**

28. What is the approximate percentage of fitting (e.g., fusion) cost to total horizontal piping cost?  
\_\_\_\_ Less than 10%. \_\_\_\_ 10 - 25%. \_\_\_\_ 26 - 50%. \_\_\_\_ 51 - 75% \_\_\_\_ 76 - 100% \_\_\_\_ None

29. What is the cost for designing a ground loop? \$ \_\_\_\_\_

30. What is the approximate cost for a site survey? \$ \_\_\_\_\_

31. What is the approximate cost for flushing and purging? \$ \_\_\_\_\_

32. What is the approximate cost for the hydrostatic test (leakage detection) of the ground loop? \$ \_\_\_\_\_

33. What is the approximate cost for restoring a site after installing a vertical loop? \$ \_\_\_\_\_

34. What is the approximate cost for restoring a site after installing a horizontal loop? \$ \_\_\_\_\_

35. What are the approximate administrative costs for the following items?

- Company Shared Cost \$ \_\_\_\_\_
- Bid Plans \$ \_\_\_\_\_
- Inspection Fees \$ \_\_\_\_\_
- Permits \$ \_\_\_\_\_
- Fines and Penalties \$ \_\_\_\_\_
- Ownership \$ \_\_\_\_\_

36. What kind of Warranty does your company offer?

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

37. What is the average total ground loop cost per installed cooling ton (including both direct and indirect cost)?

\$ \_\_\_\_\_

**Section 5. Your comments**

38. Do you have any suggestions you would like to make on how to reduce ground source heat pump costs?

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