Ground Source Heat Pumps for Homes

"Things are changing on Mother Earth!"

IGSHPA

International Ground Source Heat Pump Association (IGSHPA)

Cost of Energy Increasing!

- Natural Gas
- Home Heating Oil
- Gasoline/Diesel
- Electricity

What can you do as a Home Owner?

- Install a wind generator? Perhaps, but how many would you need to pay your big energy bill? How about a wind farm?
- Install solar panels? Perhaps, but how many would you need to pay your big energy bill? Do you really want them on top of your house? What about replacing your roof in a hail storm?
- What can you do to produce Hydroelectric energy? Nothing, but invest in Coops!
- Replace or install GSHP? Most reasonable answer: Because GSHP is a conservation method, not a energy producing method, GSHP will cut your cost of energy up front by using less and reduce maintenance cost.

Add up Alternate Energy Savings

Wind+Solar+Others ≠ GSHP

- If you added up all the alternative renewable energy sources together including Wind, Solar, and Others the total would not equal the savings in energy by using ground-source heat pumps (GSHP)*.
- Extensive use of GSHP Systems would exceed carbon dioxide savings proposed by the limits set by the Kyoto Protocol in 1997*.

*Executive Director IGSHPA, Jim Bose, Ph.D., P.E.

Habitat for Humanity – Energy Saving Homes

- Hope Crossing OKC
- 240 homes being built (50/year over 5yrs)
- 110 homes with Geothermal Heat Pump as of May 7, 08
- Each home has one bored heat exchanger 395 feet deep for GSHP

Daniel Ellis, President, ClimateMaster, Inc, OKC
"Field Experience with Ground-Source Heat Pumps in Affordable Low energy Housing" 22 May 08 Zurich, Switzerland

How a Ground Source Heat Pump System Works for a Residence

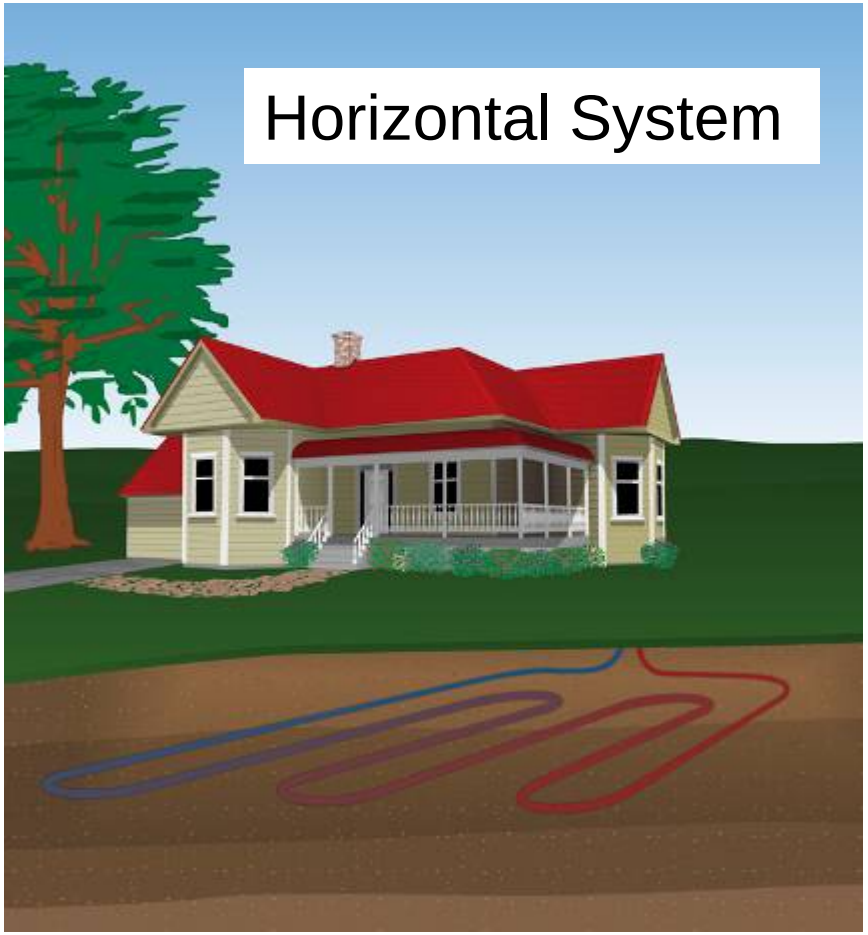


Image courtesy of Climate Master

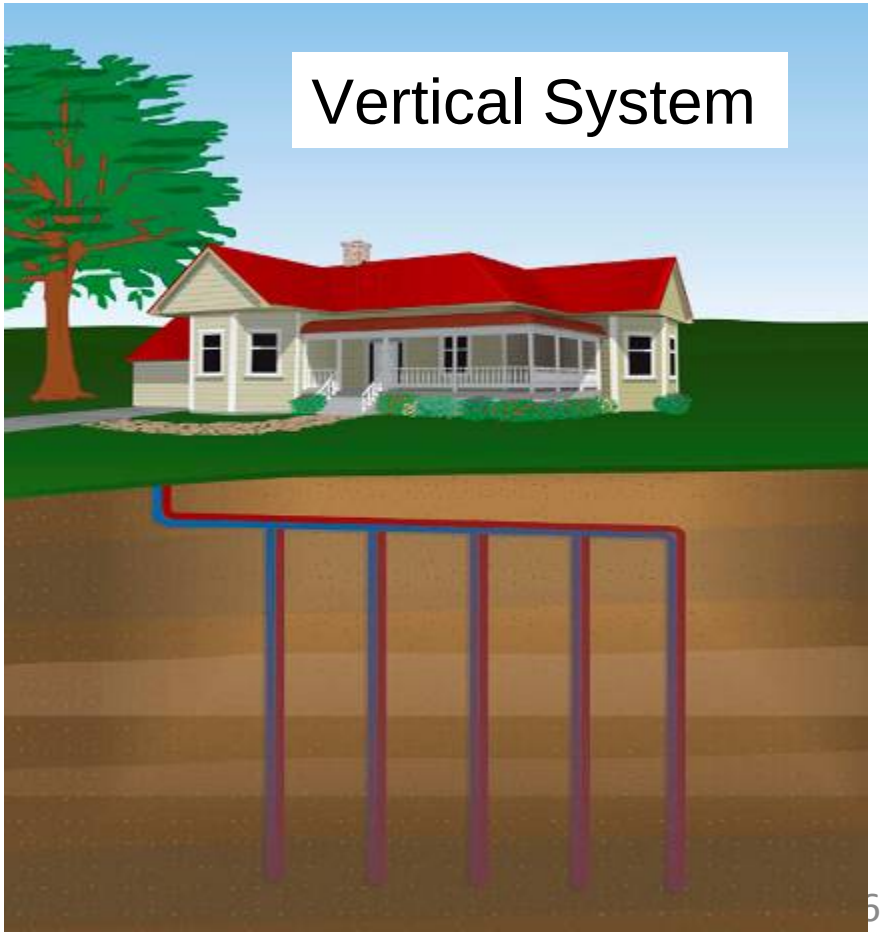


Image courtesy of Climate Master

Other Ground Source Systems

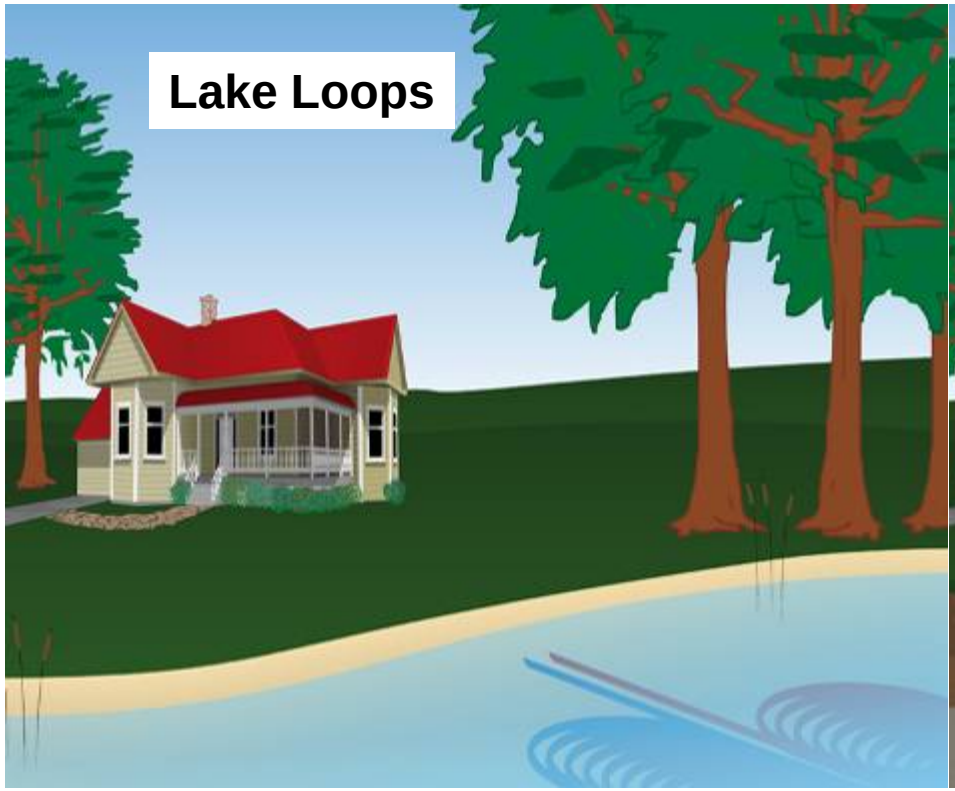


Image courtesy of Climate Master

Lake Loops are usually very economical to install. If a pond or lake at least 8 feet deep is available, lake loops can utilize the water (rather than soil) for heat transfer. Reduced installation costs are characteristic of this type of loop system.

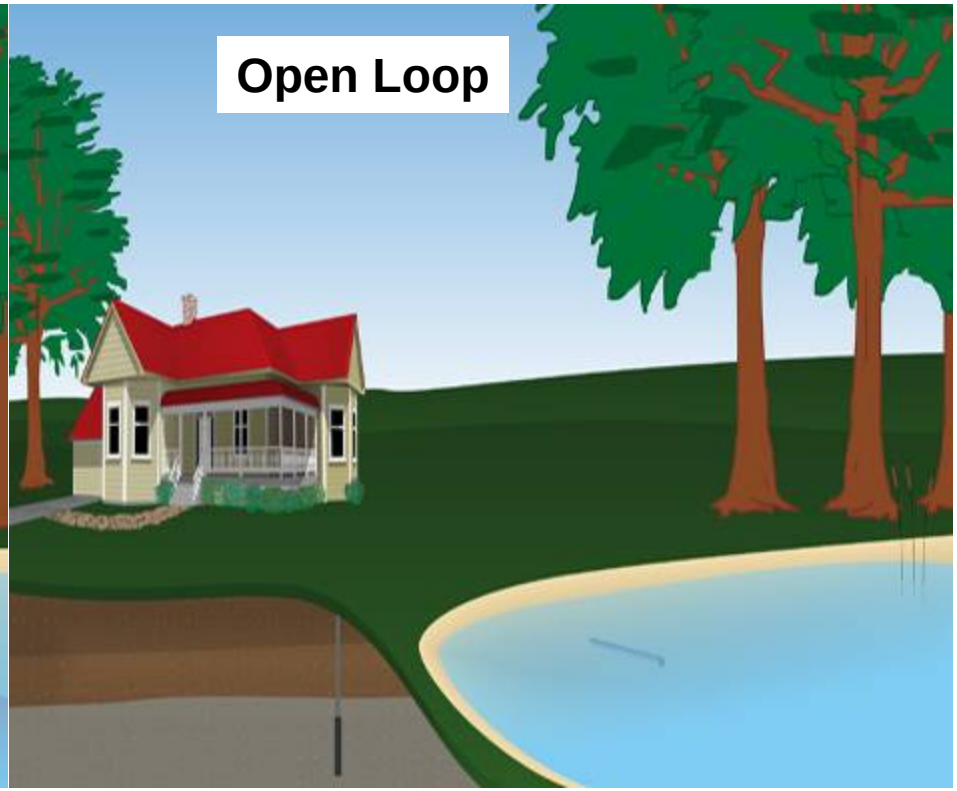
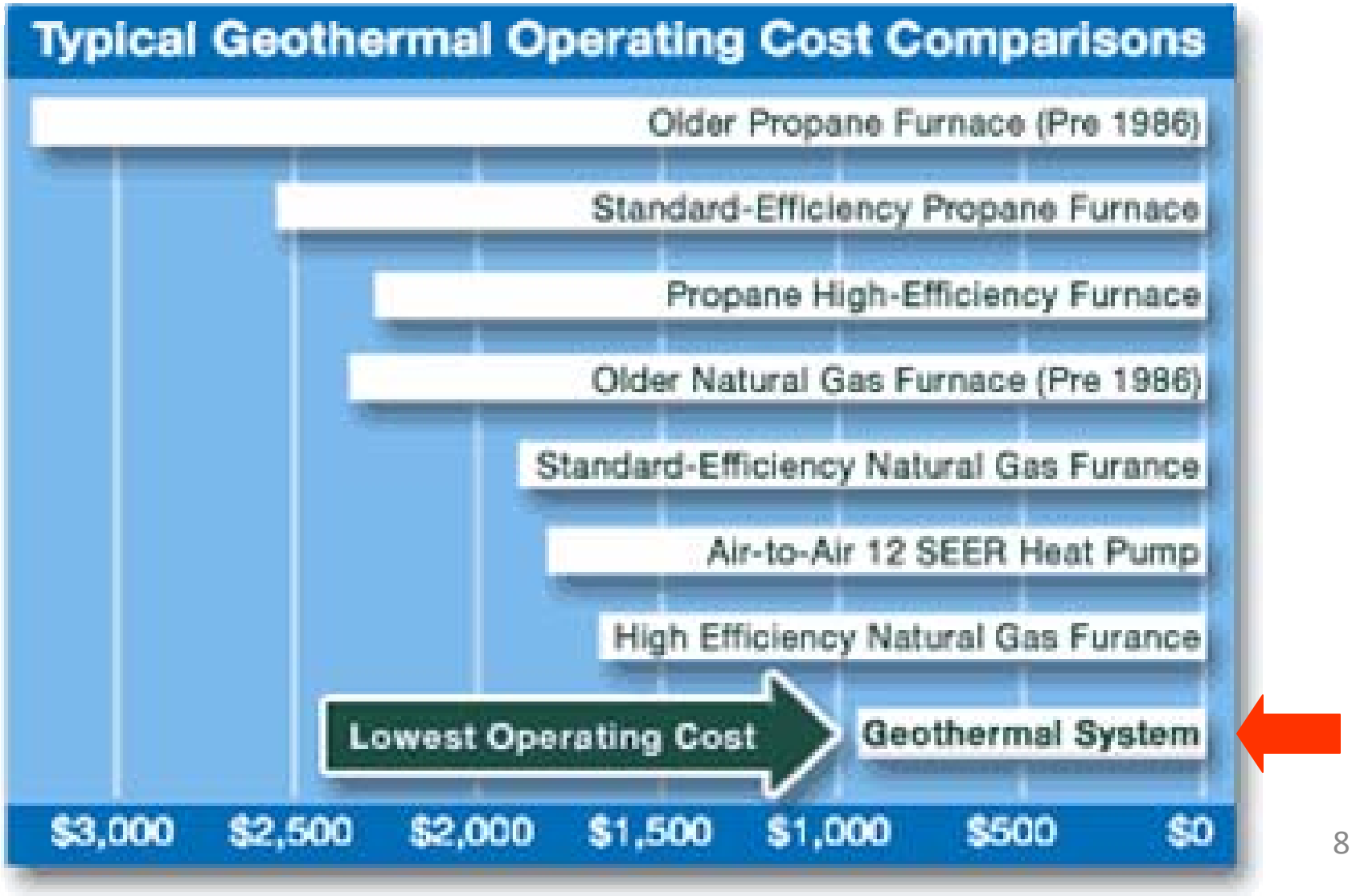


Image courtesy of Climate Master

Open Loop installations actually pump water from an underground aquifer through the geothermal unit and then discharge that water to a drainage ditch or pond. Discharging water to a pond or lake is considered ideal.

Benefits-Low Utility Bills



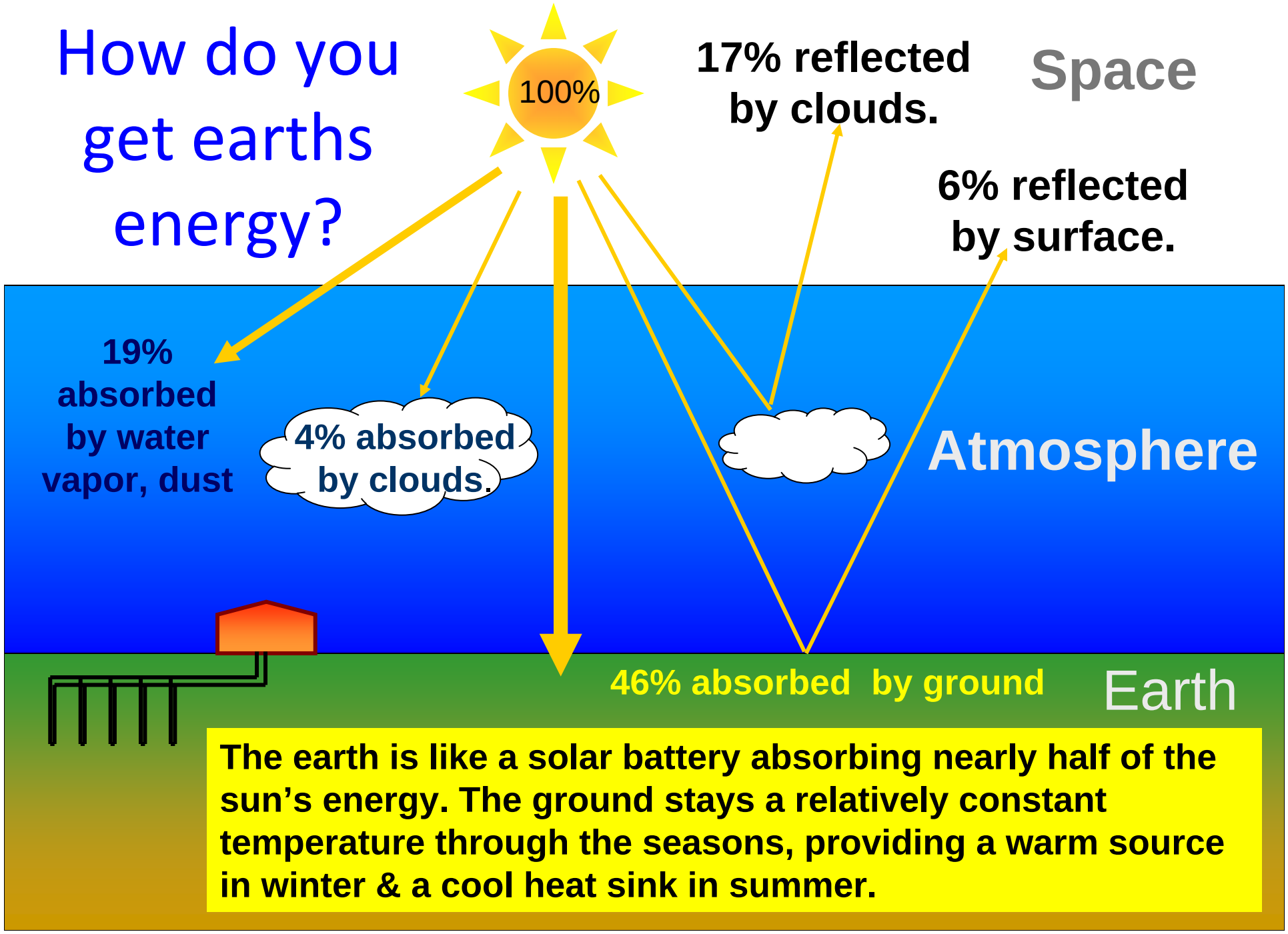
Benefits-Geothermal Heating and Cooling

- Geothermal has no flame, no flue, no odors, and no danger of fire or fumes and a long life.
- Unlike traditional air conditioners or heat pumps, geothermal units have no noisy outdoor fans to disturb you or your neighbors. *No Outside Compressor noise.*
- You can get heating, central air conditioning, and domestic hot water. . . three important benefits from a single compact unit.

Benefits-Geothermal Heating and Cooling

- Geothermal systems deliver "even" space conditioning year round and increased dehumidification during hot summer weather.
- Lot less maintenance
- *“Not only is it almost twice as efficient as a forced-air system, it lasts twice as long and has few components that can go wrong."*
  Bruce Hancock home builder Tennessee

How do you get earths energy?

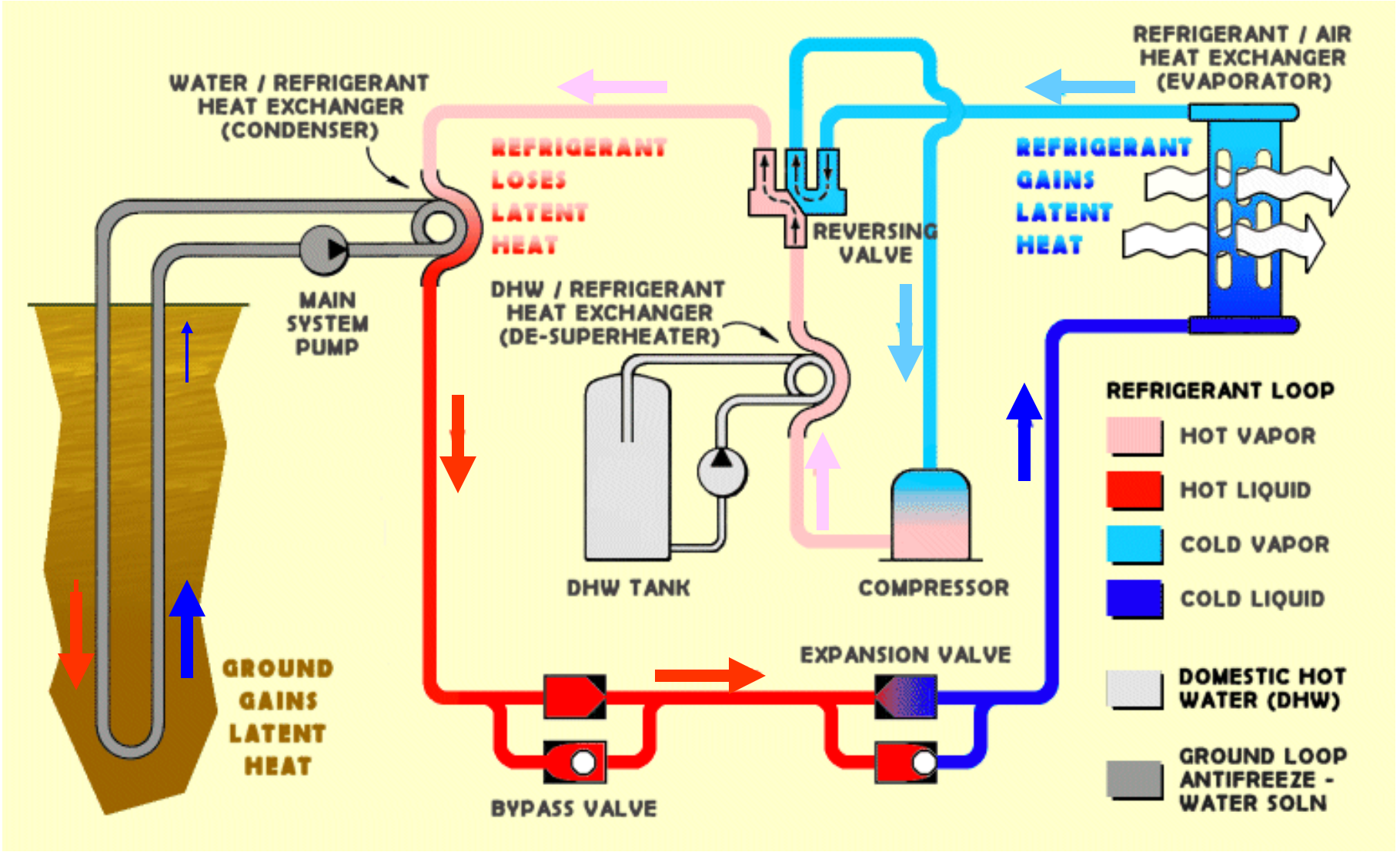


The earth is like a solar battery absorbing nearly half of the sun's energy. The ground stays a relatively constant temperature through the seasons, providing a warm source in winter & a cool heat sink in summer.

How do you get earths energy?

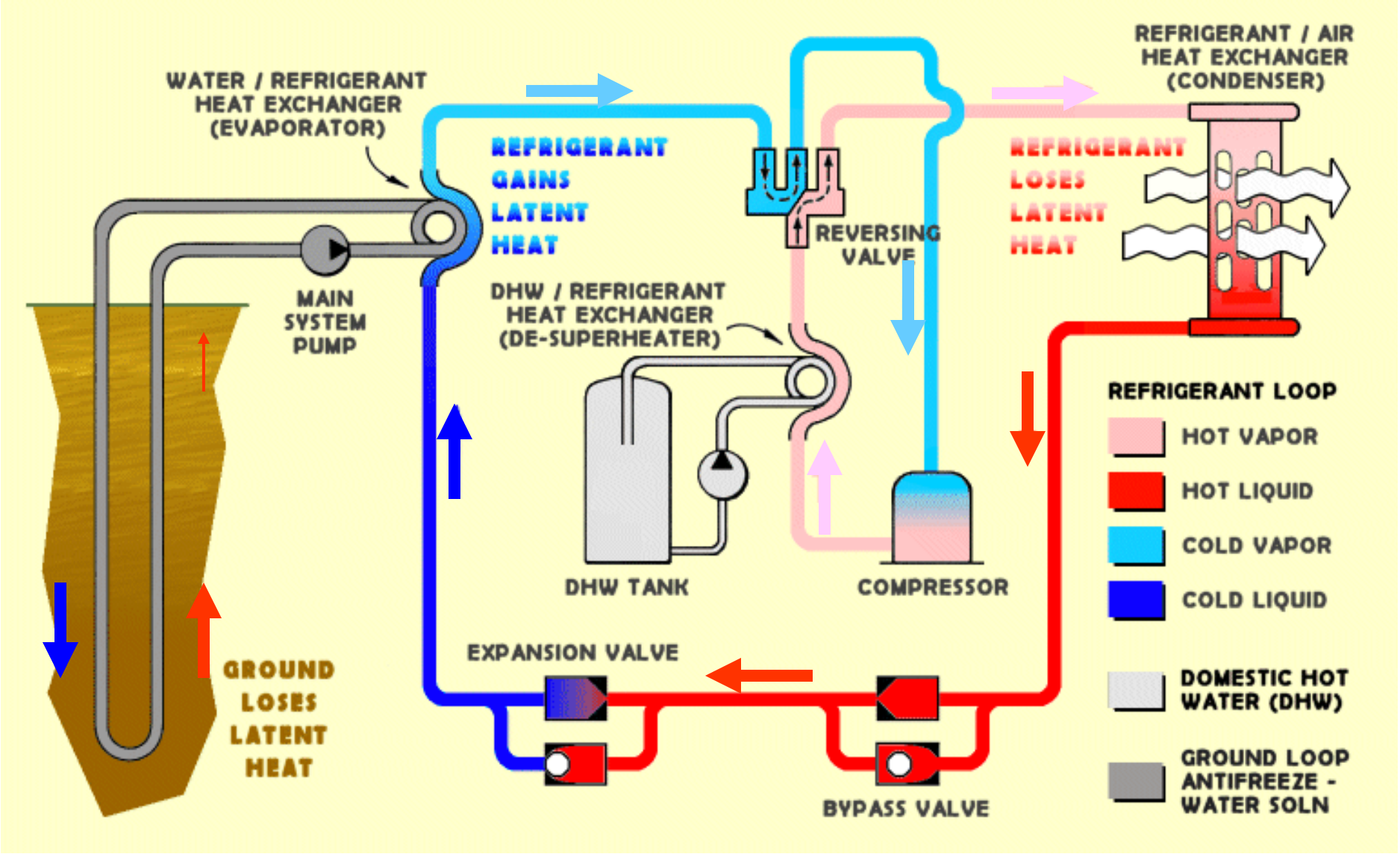
- Earth absorbs almost 50% of all solar energy and remains a nearly constant temperature of 50°F to 70°F depending on geographic location.
- **Cooling-In the summer**, the system reverses and expels heat from your home to the cooler earth via the loop system. This heat exchange process is not only natural, but is a truly ingenious and highly efficient way to create a comfortable climate in your home.
- **Heating-In winter**, water circulating inside a sealed loop absorbs heat from the earth. Here it is compressed to a higher temperature and sent as warm air to your indoor system for distribution throughout your home.

How the earth works to save you energy! **Cooling**



Geo4VA - This is a Special Energy Project funded by the U.S. Department of Energy's State Energy Program through the Virginia Department of Mines, Minerals, and Energy.

How the earth works to save you energy! **Heating**



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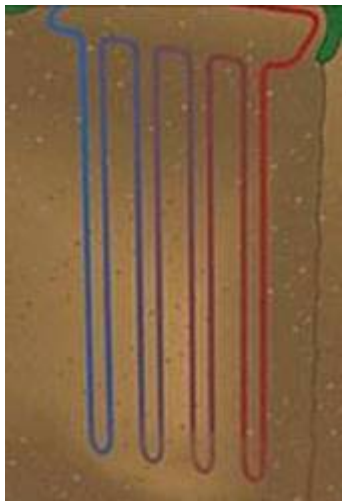
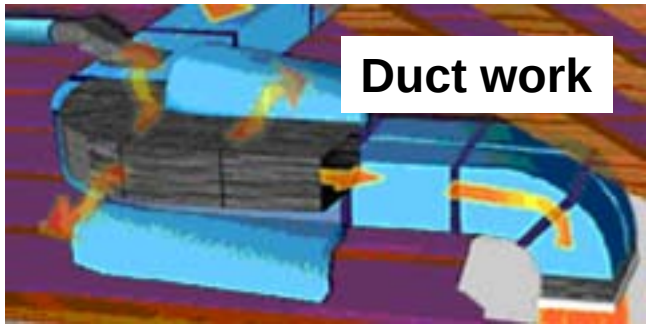
Parts of a Ground Source Heat Pump System



Ground Loop

Heat Pump



- Ground Loop (geoexchange)
  - Closed loop (most used)
  - Open loop
- Heat Pump
  - Water to Air HP
  - Water to Water HP (floor heating)
- Distribution System
  - Duct work
  - And/or Hydronic-water in piping in floor.

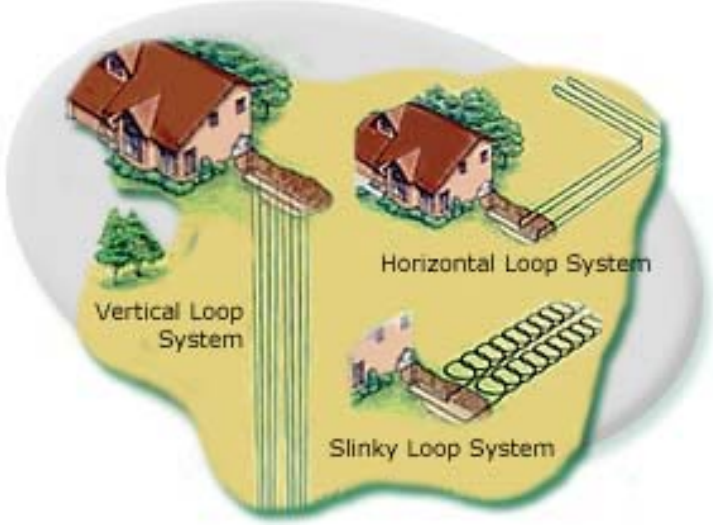
Ground Closed Loop System

Trenching

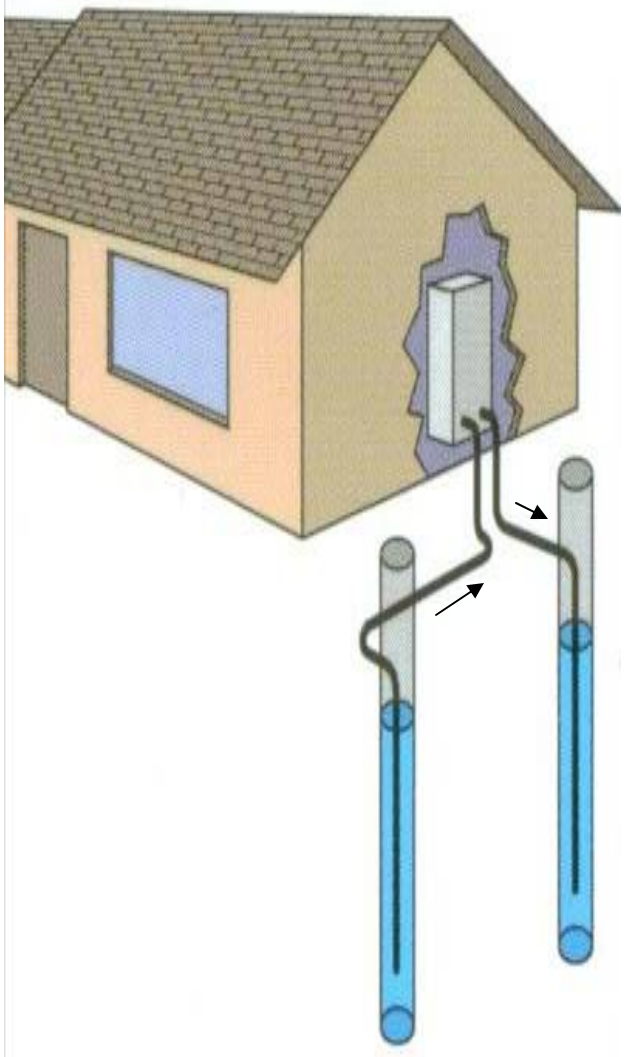
- Trenching-horizontal loops with one or more pipes in loops. 4’-5’ deep.
- Or Vertical Boring – vertical loop bore hole with one pipe down hole looping back to surface. Restricted space.
- Or Directional Boring - horizontal loop that can be under a building.

Vertical Boring

Directional Boring



Ground Open Loop System



- Groundwater systems - groundwater is available at reasonable depth and temperature.
- The groundwater is pumped from the delivery well to the heat pump and from there to the sink well.

Ground Open Loop System

- Lake or pond – loops in water will require some horizontal trenching from house to the pond or lake.
- Lake level must be sustainable during dry season and at least deep and large enough to maintain temperature during drought periods.
- Closed loop slinky can be used in Lake too.

Ground Source Heat Pump

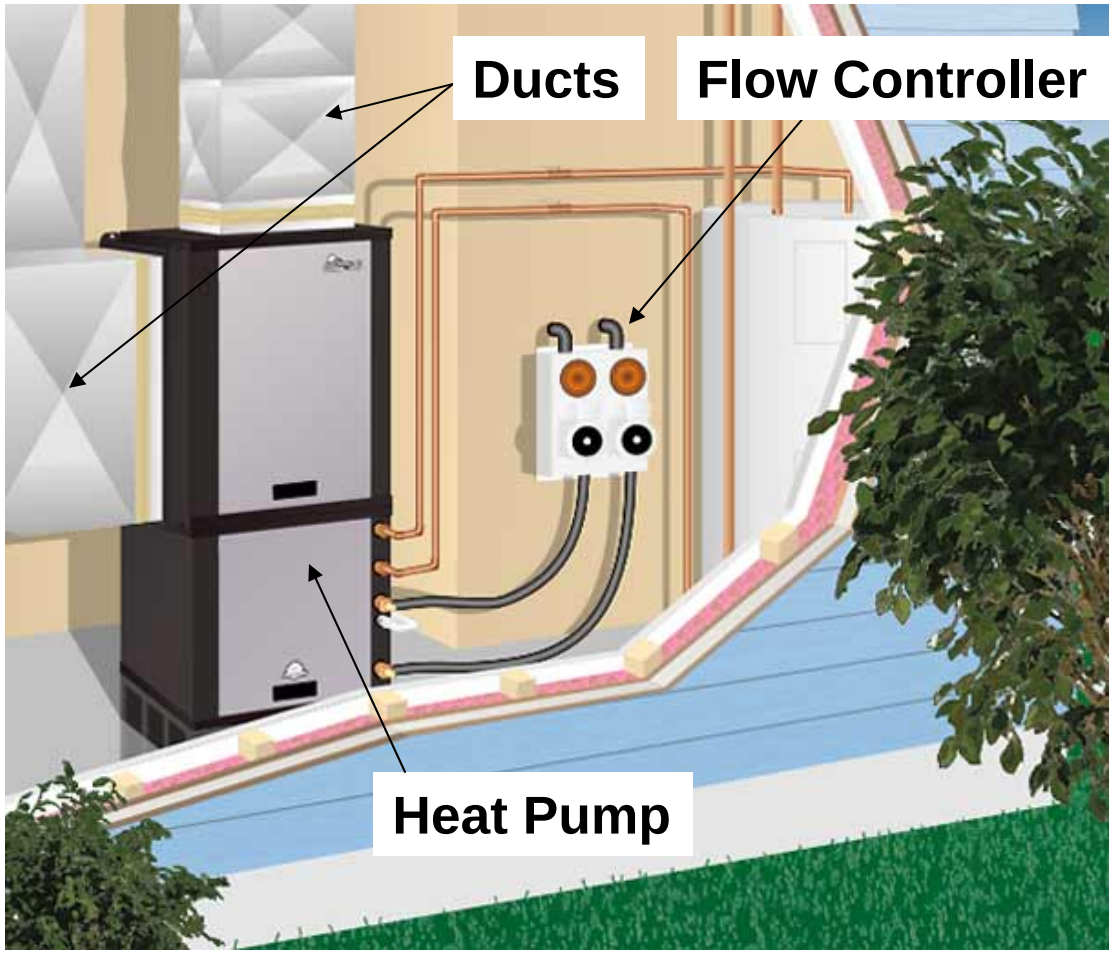
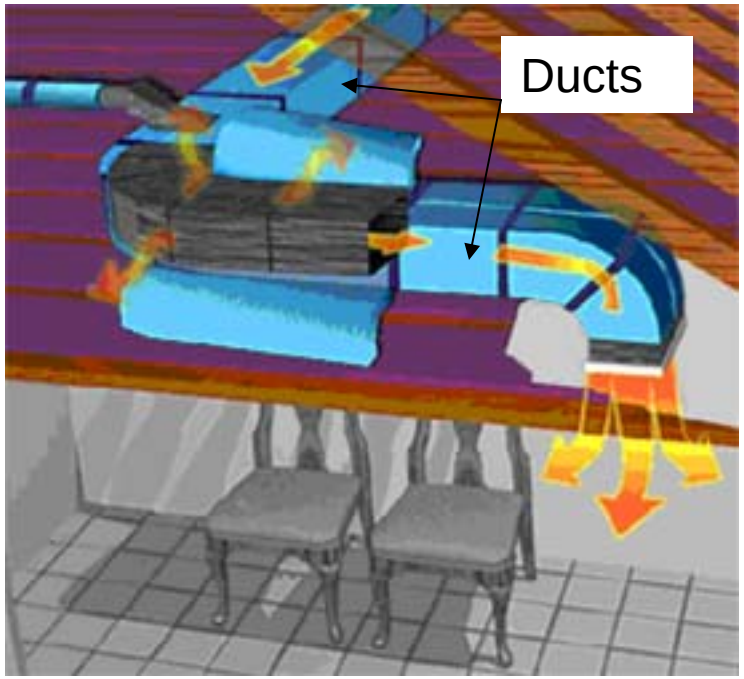
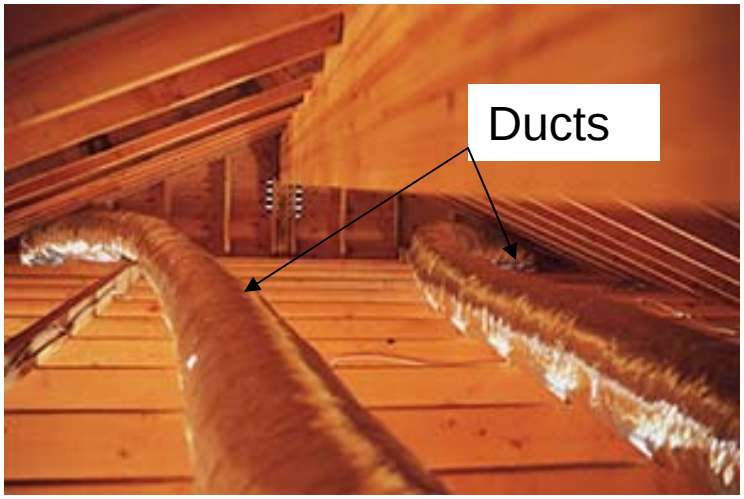


Image courtesy of Climate Master

- Water to air Heat Pump for duct heating and cooling
- Water to water Heat Pump for use as Radiant Floor Heating, Baseboards, and Fan coil heating/cooling.

Distribution Systems-Duct Work

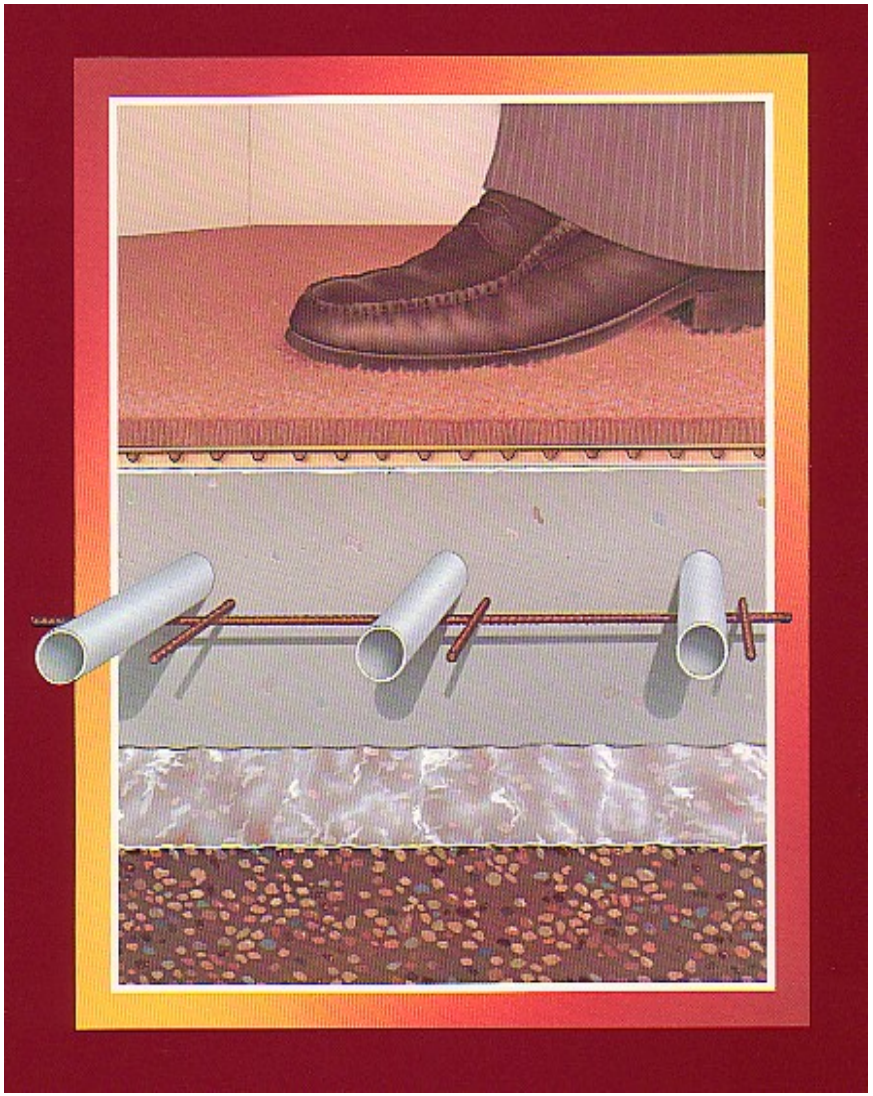




- Warm or cold air blown through ducts
- Zone Control
- Outstanding Comfort

Innovative Air Systems

Distribution Systems-Hydronic Systems



- Additional method of distribution
- Hydronic Systems – Floor Heating providing warm water distributed in floor
- Room Zone Control
- Outstanding Comfort
- When your feet are warm your body feels warm too.

Hot Water Generator

- Use of Hot water generator (desuperheater) transfers excess heat from the compressed gas to a water line that circulates water to the house's hot water tank. Added to Heat Pump
- In summer, when the air conditioning runs frequently, a desuperheater may provide all the hot water needed by a household. *Free hot water*
- Prolong the life of the Air Conditioning system and promotes improved system operation.

Cost and Payback

- A Ground Source Heat Pump (GPHP) may cost more than a conventional system, but payback will usually be 2-10 years.
- How much more depends on where you live and which GSHP you use.
- Cost depends on available contractors who are accredited designers and installers.
- Open Loop systems do not require some specialized contractors such as drillers and trenchers and are less affected by this problem.

Residential GSHP System Research*

- Residential GSHP systems were documented for 184 case studies which include 24% vertical ground-coupled, 24% horizontal ground-coupled, 21% groundwater, 3% spiral (slinky) and 28% other types.
- Of these systems, 127 GSHPs were monitored (metered) and compared to 111 conventional energy systems of which only 46 were monitored.

  http://geoheat.oit.edu/pdf/hp1.pdf

***Geo-Heat Center**
Oregon Institute of Technology
3201 Campus Drive
Klamath Falls, OR 97601

Prepared For:
U.S. Department of Energy
Geothermal Division
April 1995

Residential GSHP Annual Savings*

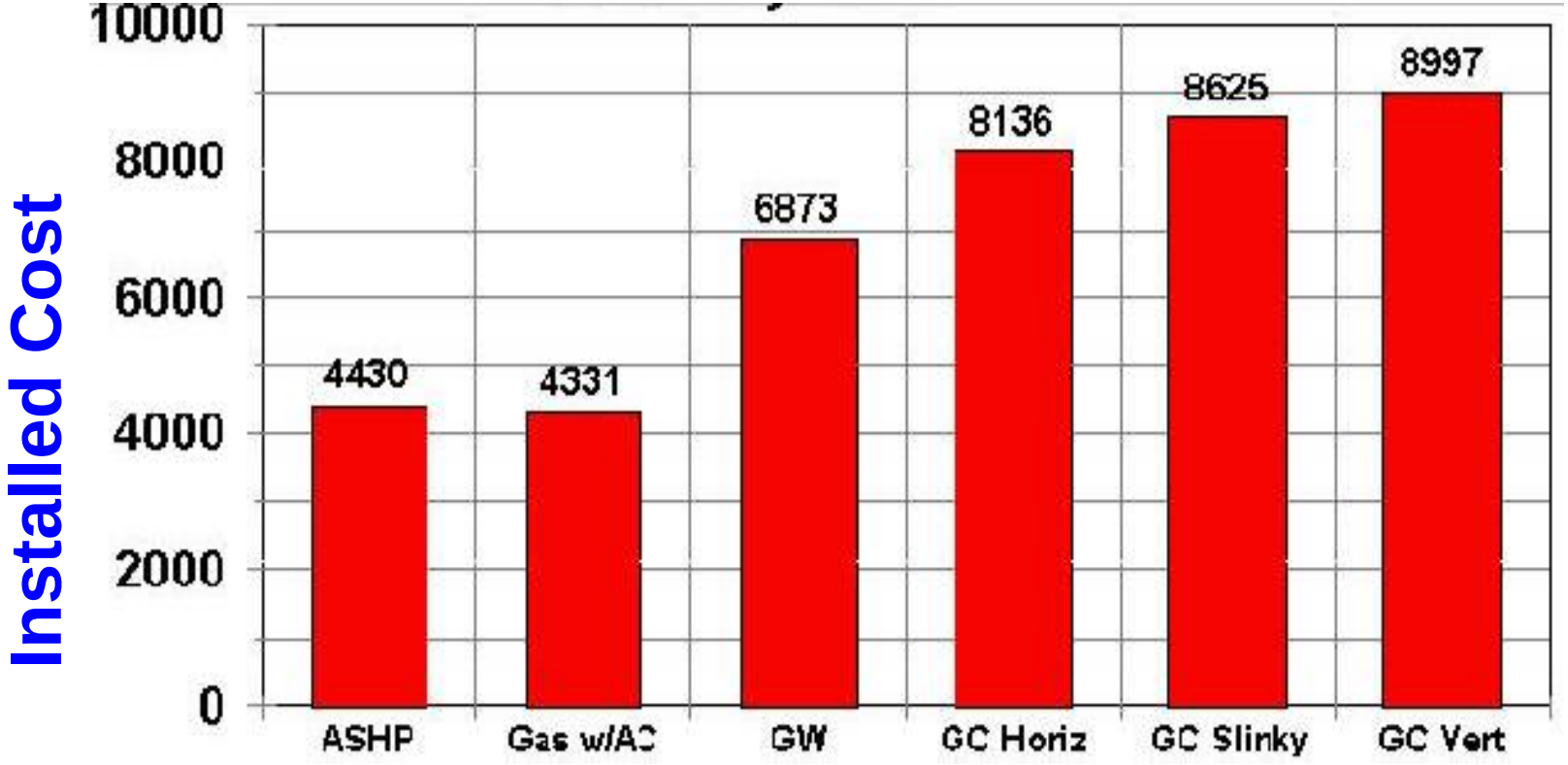
- The average annual energy savings of GSHP systems ranged from 31% to 71% and dollar savings ranged from 18% to 54%. Study* **April 1995.**

Conventional System	GSHP Mean Annual Savings (%)	
	Energy	Dollars
Electric Resistance Heat/AC	57%	54%
Air-Source Heat Pump	31%	31%
Natural Gas Furnace/AC	67%	18%
Oil Furnace/AC	71%	33%
Other (propane, unspecified)	46%	39%

***Geo-Heat Center, Oregon Institute of Technology**

Total Installed Cost-3 Ton System*

Cost shown include: units, ductwork, all associated components and the ground loop



GW Ground Water HP
GC Ground Coupled HP
ASHP Air Source HP

***AN INFORMATION SURVIVAL KIT FOR THE PROSPECTIVE GEOTHERMAL HEAT PUMP OWNER**

http://geoheat.oit.edu/ghp/survival.pdf

Prepared For:
U.S. Department of Energy, Office of Geothermal Technologies, February 2001

Installed Cost for 3 ton Ground Loop*

- $4,000 Average Conventional HVAC System
- $7,500 Average Ground Source Heat Pump will cost more.
- Extra $3,500 can be added to mortgage for $30 per month.
- Savings per month ranges from 30% to 60%
- Energy cost savings will easily exceed that added mortgage amount over the course of each year.

***US Department of Energy**
Energy Efficiency and Renewable Energy
Consumer's Guide "Geothermal Heat Pumps
September 19, 2005

Some Quotes

- The Iowa Energy Center says “a geothermal heat pump is the most efficient heating and cooling system available, returning up to $4 of heating or cooling energy for $1 of electricity consumed.”
- The U.S. Department of Energy's Consumer's Guide to Energy Efficiency and Renewable Energy saying “they use 25 percent to 50 percent less electricity than conventional heating or cooling systems.”
- Midnight Oil Co. “calculates the cost of heating a 2,000-square-foot, home at $4.40 a gallon for heating oil this winter at roughly $7,920. With the geothermal system, the cost is $1,833 in electricity, an energy savings of $6,087.”
- U.S. Environmental Protection Agency, “installing a geothermal system in a typical home is the environmental equivalent of planting 750 trees, or saving three-quarters of an acre of rain forest.”

H. R. 1424 Emergency Economic Stabilization Act of 2008

Sec. 105. Energy credit for geothermal heat pump systems

- Residence: Capped at "$2,000 with respect to any qualified geothermal heat pump property expenditures"
- Copy at http://financialservices.house.gov/essa/essabill.pdf

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