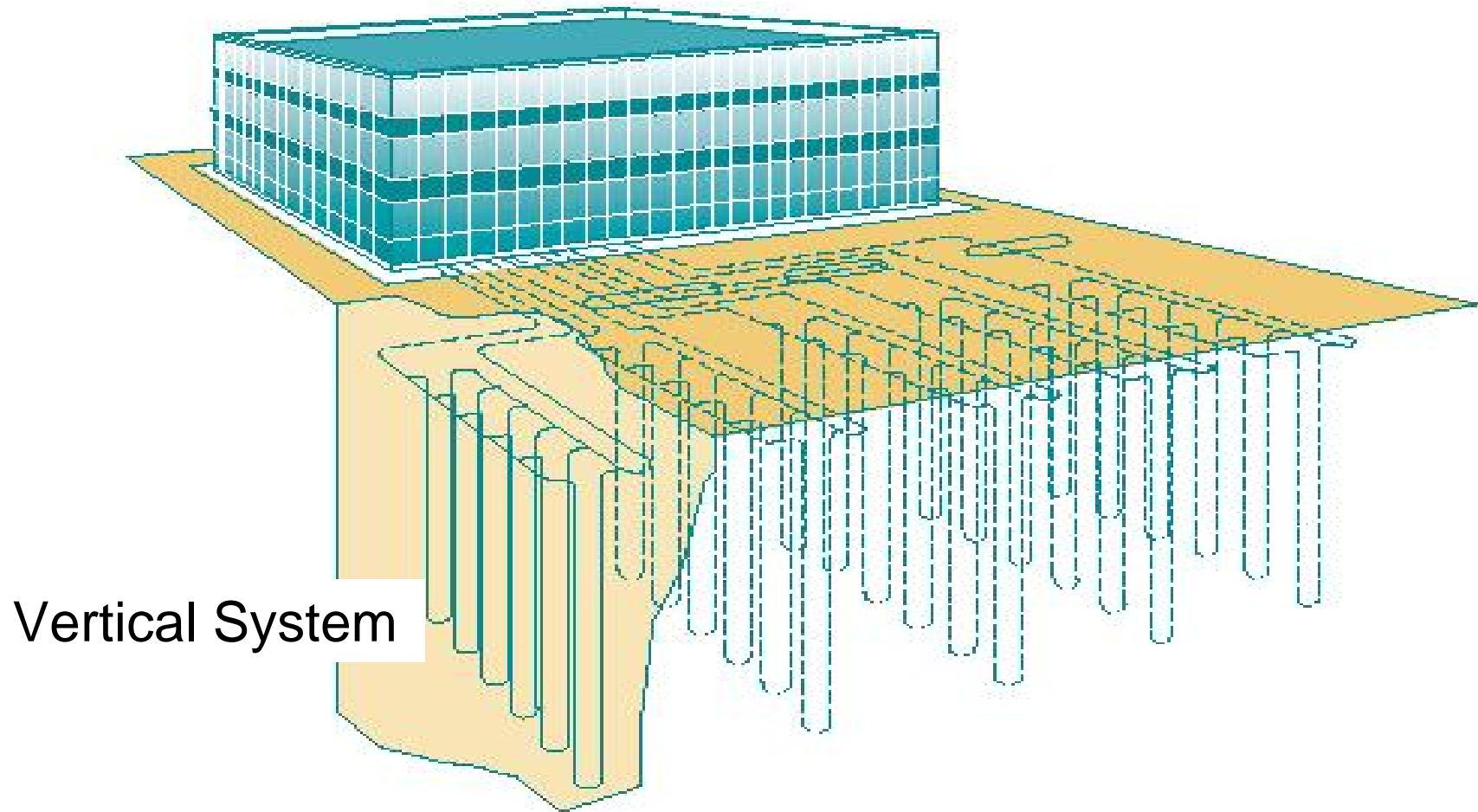


How a Ground Source Heat Pump Works for Government Buildings



Geothermal avoids the need for outdoor equipment...



..reducing vandalism and liability

Image courtesy of Climate Master



Why geothermal heat pumps?

- The world's largest installation of geothermal heat pumps, at **Fort Polk in Louisiana in 1998**
- cost \$18.9 million and will pay for itself in 20 years.
- 4,003 geothermal heat pumps
- **Reduce** carbon dioxide by 32,000 tons, sulphur dioxide by 145 tons, and nitrogen oxides by 86 tons, and using the energy equivalent to 57,000 fewer barrels of oil.
- Fort Polk \$345,000 annual savings for 20 years then savings of \$2.2 Million per year.

Hugh and Shonder 1998 ACEEE summer study on Energy efficiency in buildings.

Installed Heat Pumps



Fort Knox, KY, Disney Barracks Complex



Fort Knox, KY, Creating Bore holes for GSHP

- Fort Knox, KY – Disney Barracks Complex conversion
- Fort Sill, OK – Building 2025 and other bldgs
- Camp Humphreys, Korea – Heat Plant
- Fort Benning, GA – Heat Pumps
- Fort Gordon, GA – 13 buildings
- M.O.T. Sunny Point, NC – Heat Pumps
- McAlester AAP, OK - Heat Pumps and water sys

Benefits-Geothermal Heating and Cooling

- Operating unit inside and heat exchanger loop is underground...no external compressor
- Low operating and maintenance cost 25% to 50% less than conventional system.
- High energy efficiency all year long
- GSHP are among the quietest ever designed...similar to a refrigerator in sound.
- Geothermal has no flame, no flue, no odors, and no danger of fire or fumes and a long life.

Benefits-Geothermal Heating and Cooling



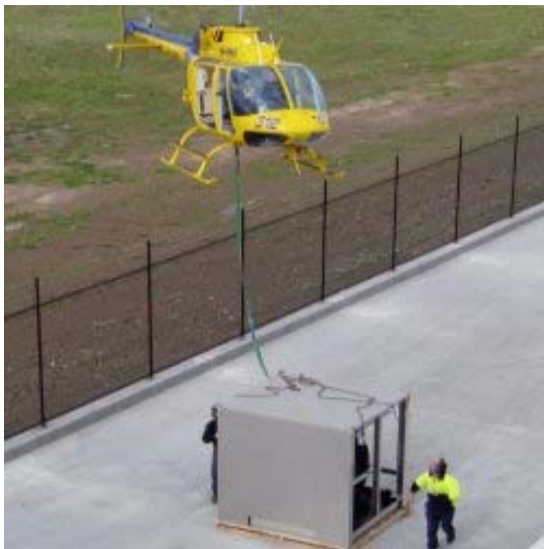
Birdville High School, Birdville, Tx GSHP

- Natural dehumidification
- **Heat** one zone or room and **cool** the other at the same time.
- **Less** space for equipment – more space for offices or storage.
- Geothermal systems deliver "**even**" **space conditioning** year round and increased dehumidification during hot summer weather.

Benefits-Geothermal Heating and Cooling

- You can get heating, central air conditioning, and domestic hot water, **three important benefits** from a single compact unit.
- **Dependable, Reliable, Long Service Life**
- Ground Loop Tubing warranties of **50+ years**
- Virtually **Free** Domestic Hot Water
- Boilerless/Towerless operation
- Significantly **reduce** full time maintenance staff and eliminate boiler maintenance

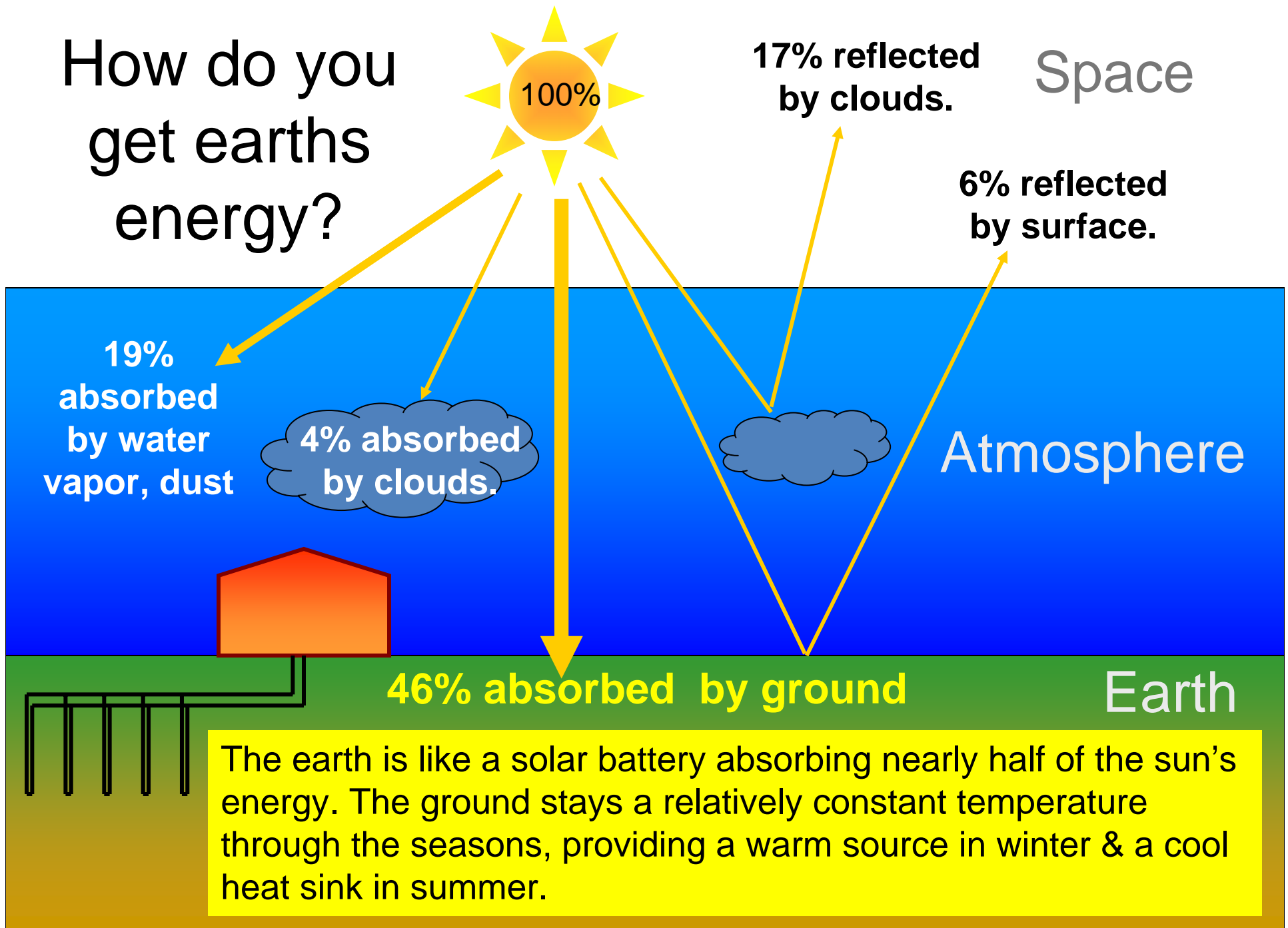
Benefits-Geothermal Heating and Cooling



Eliminate cooling tower

- **Eliminate** chemical and other costs associated with the prevention of scaling and bacterial growth
- **Eliminate** year-round tower operation that requires a lot of expense especially during the colder weather months
- **Low** source energy use and low air pollutant emissions-**green technology**

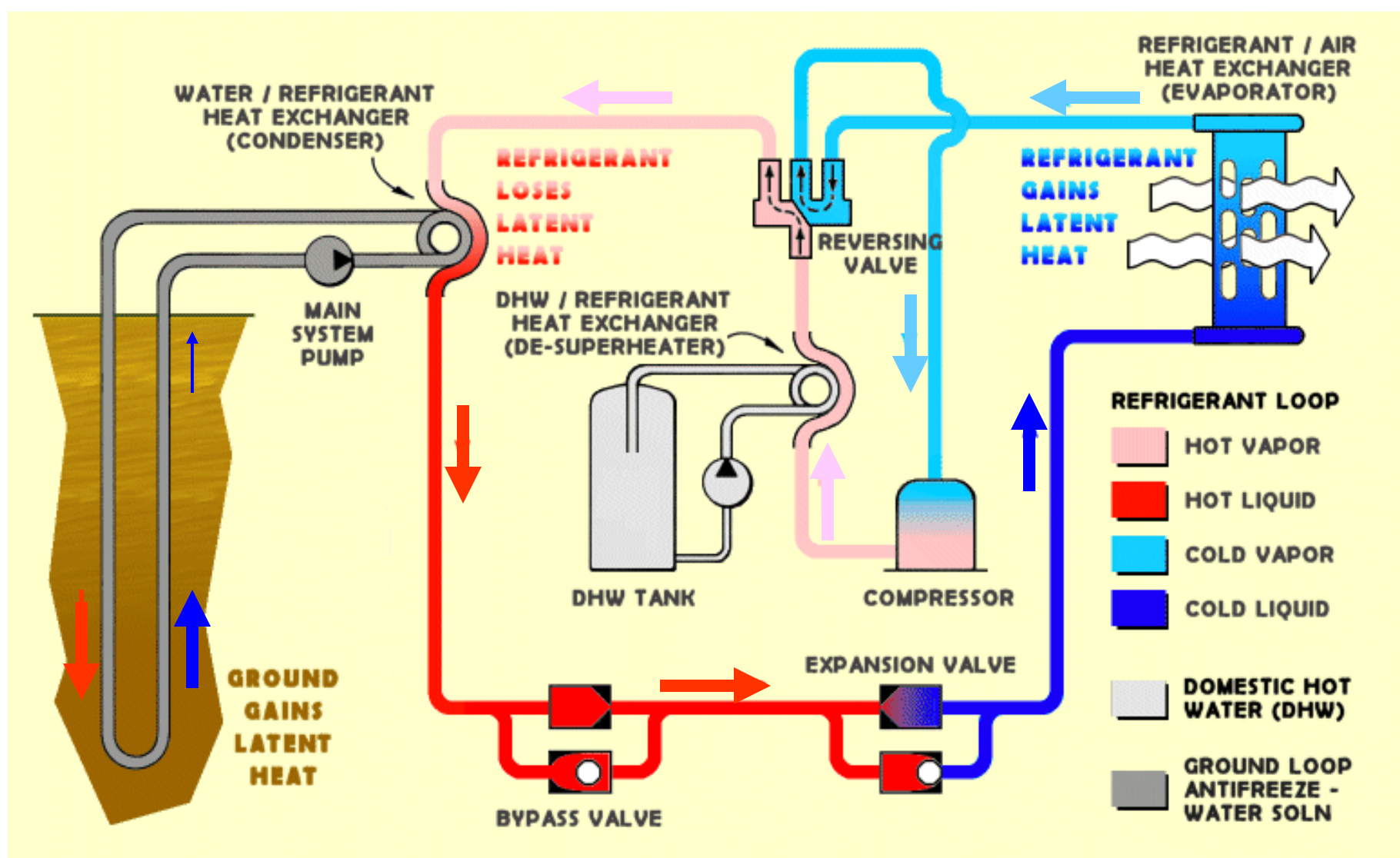
How do you get earth's energy?



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.
- 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 building.
- Cooling-In the summer, the system reverses and **expels heat from your building** 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 building.

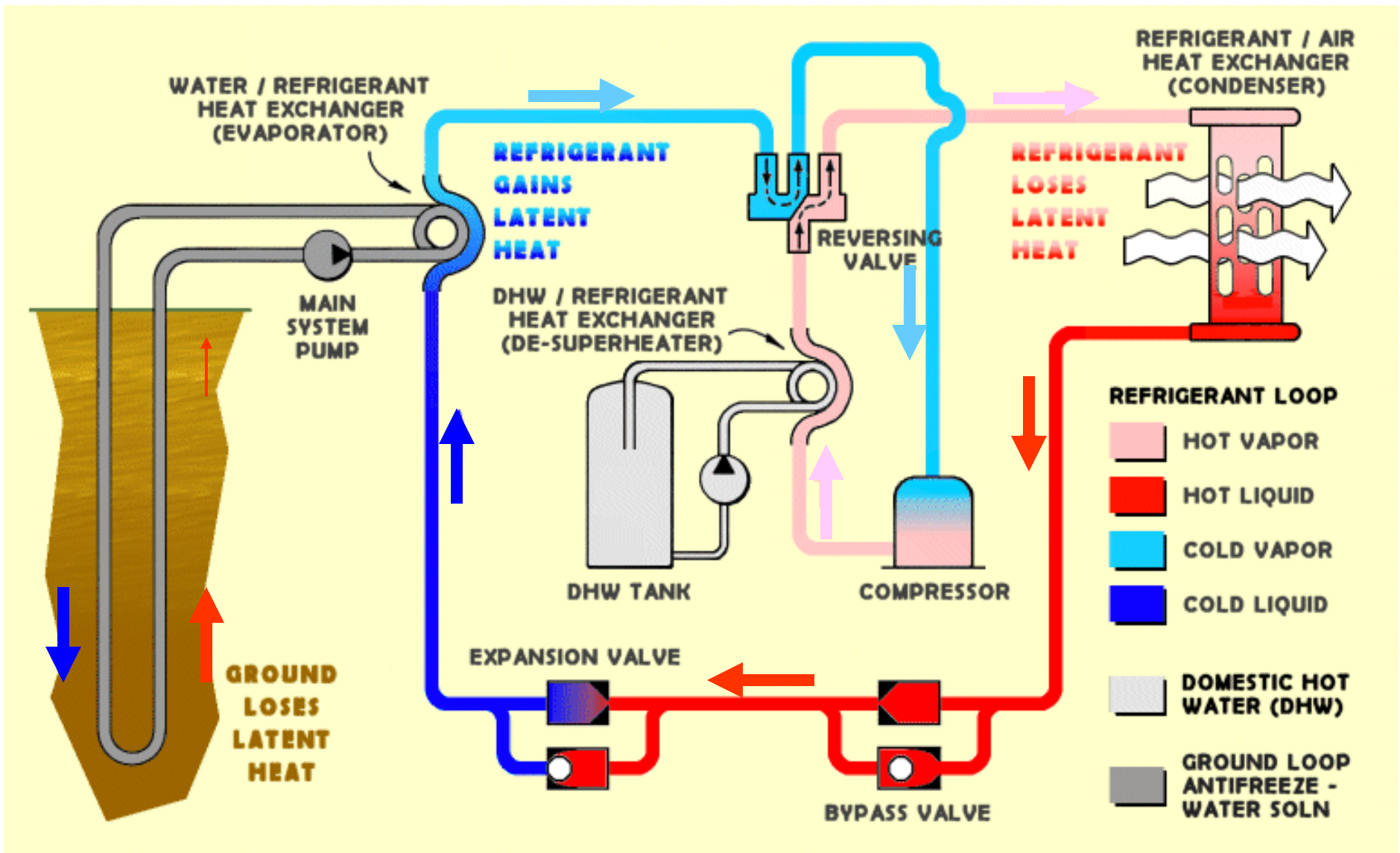
How the earth works to save you energy! **Cooling**



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.



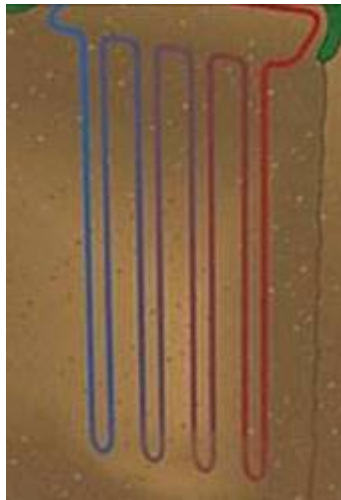
How the earth works to save you energy! **Heating**



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.



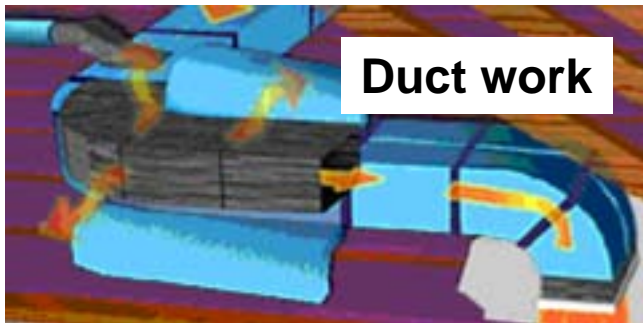
Parts of a Ground Source Heat Pump System



Ground Loop



Heat Pump



Duct work

- 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

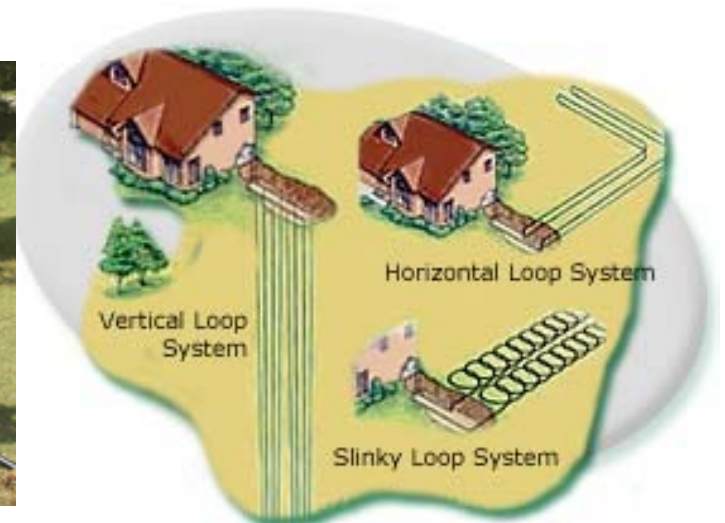
- Trenching-horizontal loops with one or more pipes in loops. 4'-6' deep.
- Or Vertical Boring – vertical loop bore hole with one pipe down hole looping back to surface. Restricted space.
- Or Directional Boring - horizontal loop that can be under a building (limited space).



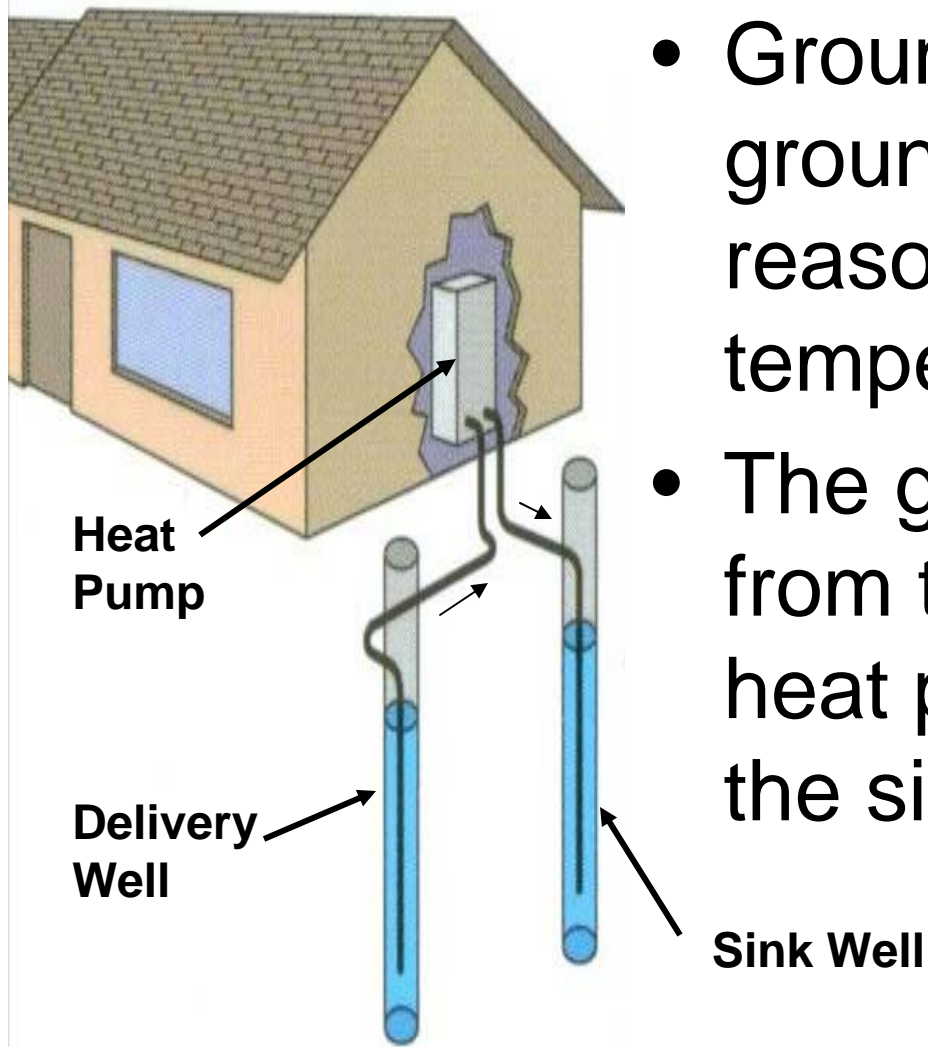
Vertical Boring



Directional Boring

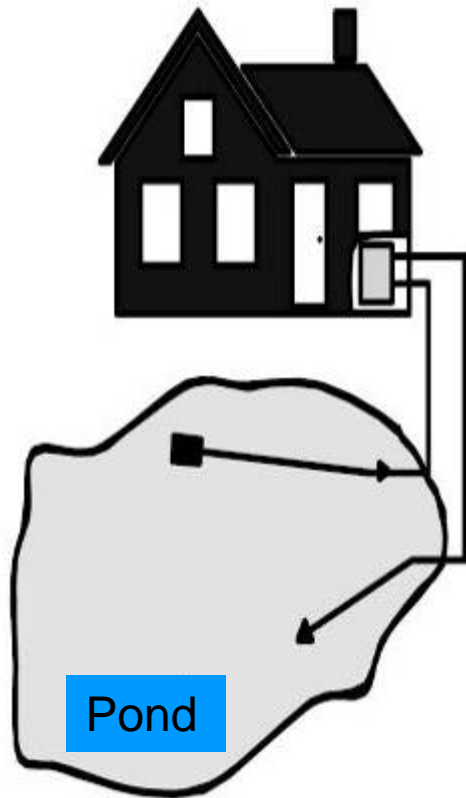


Ground Open Loop System



- 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.

New Sherman Hospital to open 2009



- Elgin, Illinois
- \$310 million
- 250 bed hospital
- 15 acre lake
- 18 foot deep
- 150 miles of Slinky
- 2,500 loops
- Estimate of Energy Savings of \$1 million per year

Several Heat Pumps within Building

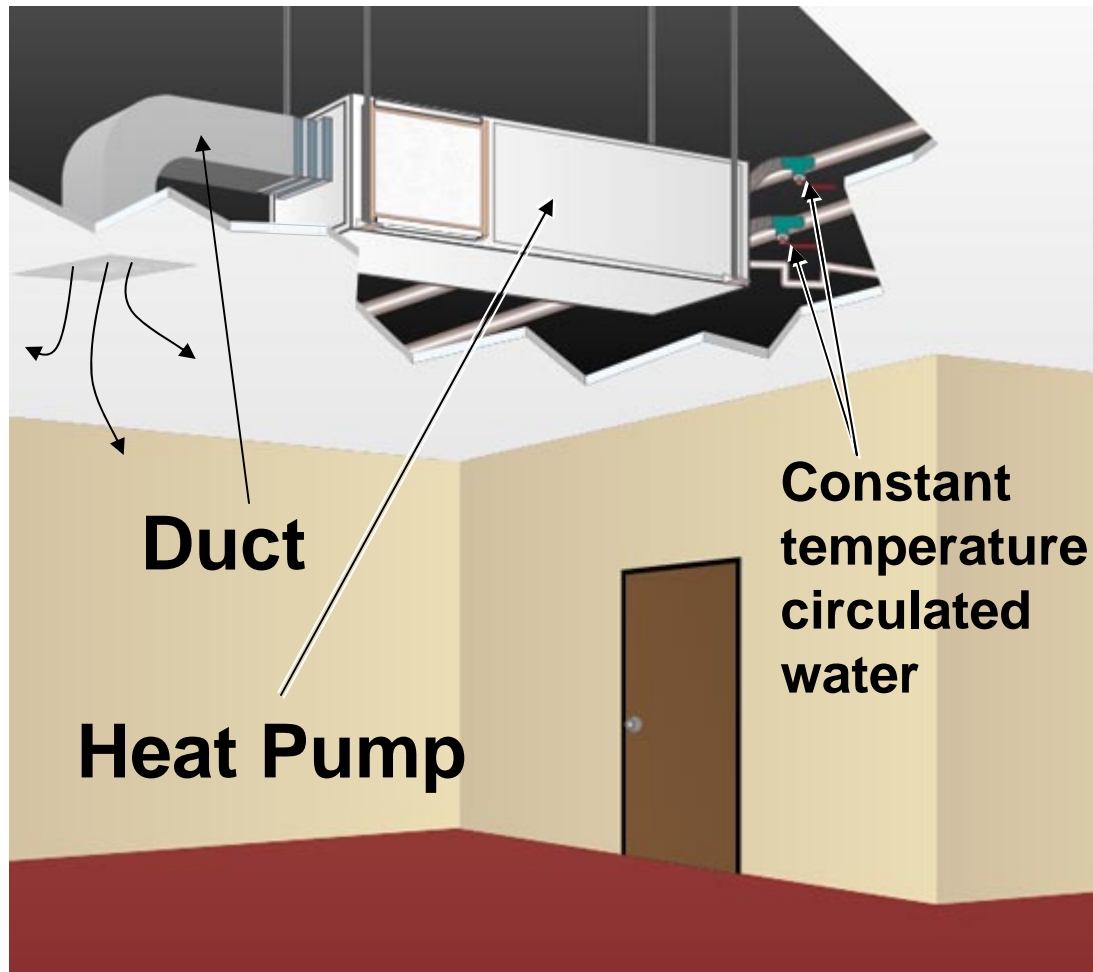
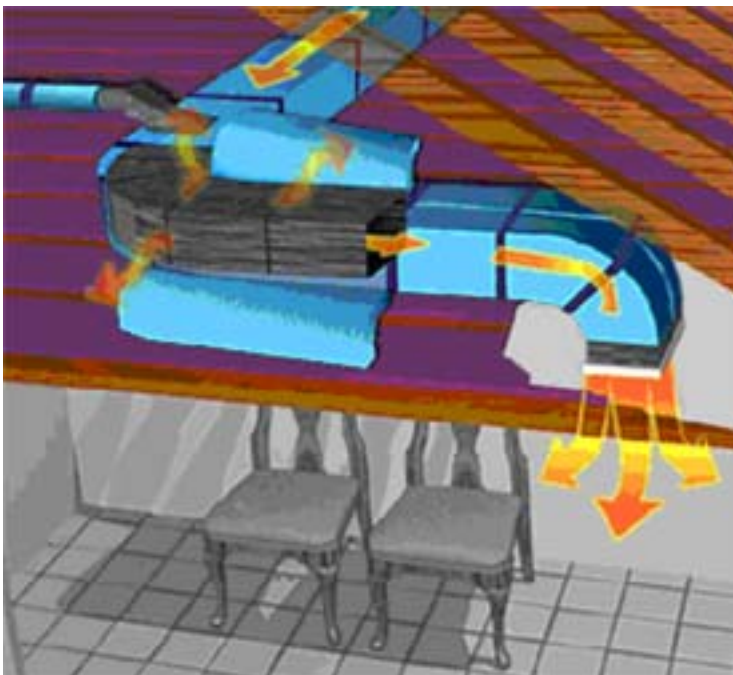


Image courtesy of Climate Master

- 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



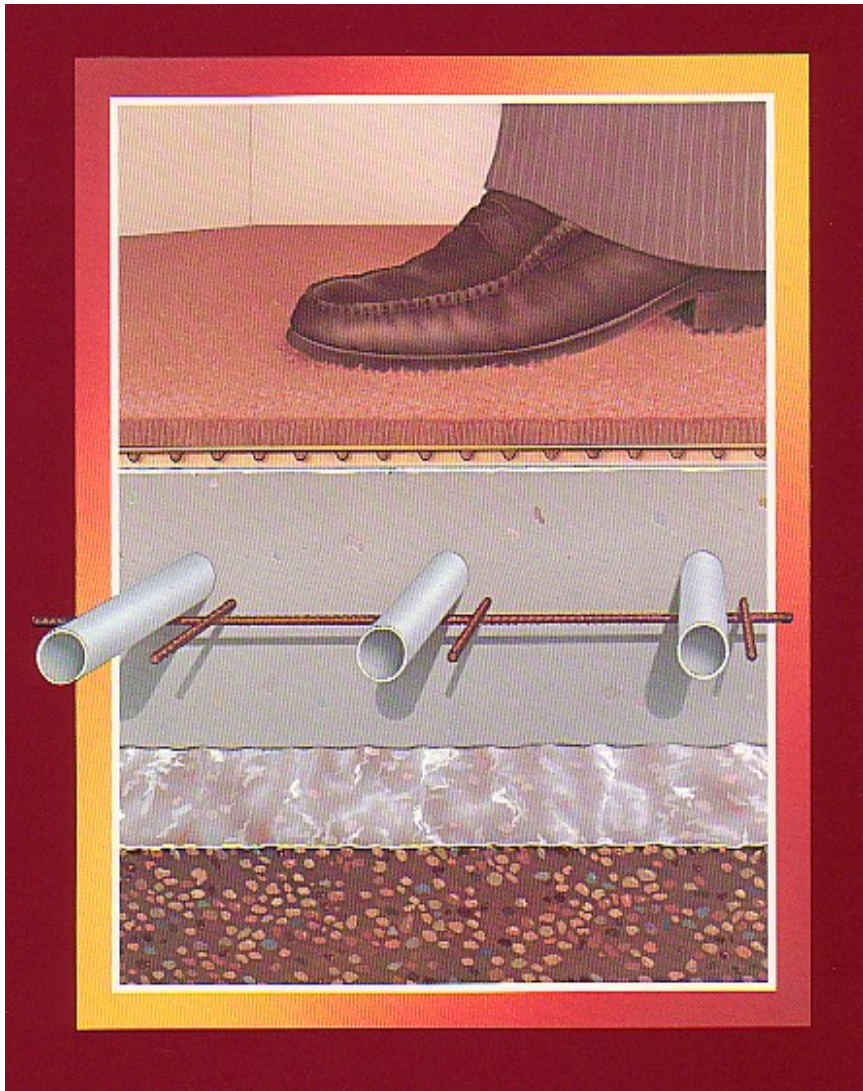
- Warm or cold air blown through ducts
- Zone Control and/or Remote Master Control
- Outstanding Comfort



Innovative Air Systems



Distribution Systems-Hydronic Systems



- 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.

Cost and Payback

- A Ground Source Heat Pump System **will cost more than a conventional system**, but **payback will usually be 2-8 years**. U.S. Department of Energy
- How much more depends on where your **building is located** and **which GSHPS** you use.
- **Cost depends** on available contractors who are accredited installers in your area.
- **Open Loop systems** do not require some specialized contractors such as drillers and trenchers and are less affected by this problem.

According to the Geothermal Heat Pump Consortium

The monumental impact of the current use of geothermal heat pump technology is equivalent to:

- Taking over 1,165,000 cars off the road
- Planting more than 346 million trees
- Reducing U.S. reliance on imported fuels by 19.3 million barrels a year.

Ground Source Heat Pumps*

- Have the lowest life cycle cost of any HVAC available today.
- Is considered the technology of choice by the Department of Energy and the Environment Protection Agency.
- Will normally cost about 25% more than the least expensive roof top units or split systems that are available but will pay back that 25% extra cost between two and three years.

*Ground Source Heat Pumps: A Good Fit For Schools

By: John M. Vanderford, Vanderford and Associates - Tuesday, Jan 24, 06



Ground Source Heat Pumps provide the following advantages:

Birds Nest China



- Best Regulated Comfort
- Lowest Maintenance and Longest Equipment Life Cycle
- Reasonable First Costs
- Lowest Energy Costs
- Adaptability to new and retrofit design

<http://www.igshpa.okstate.edu>

