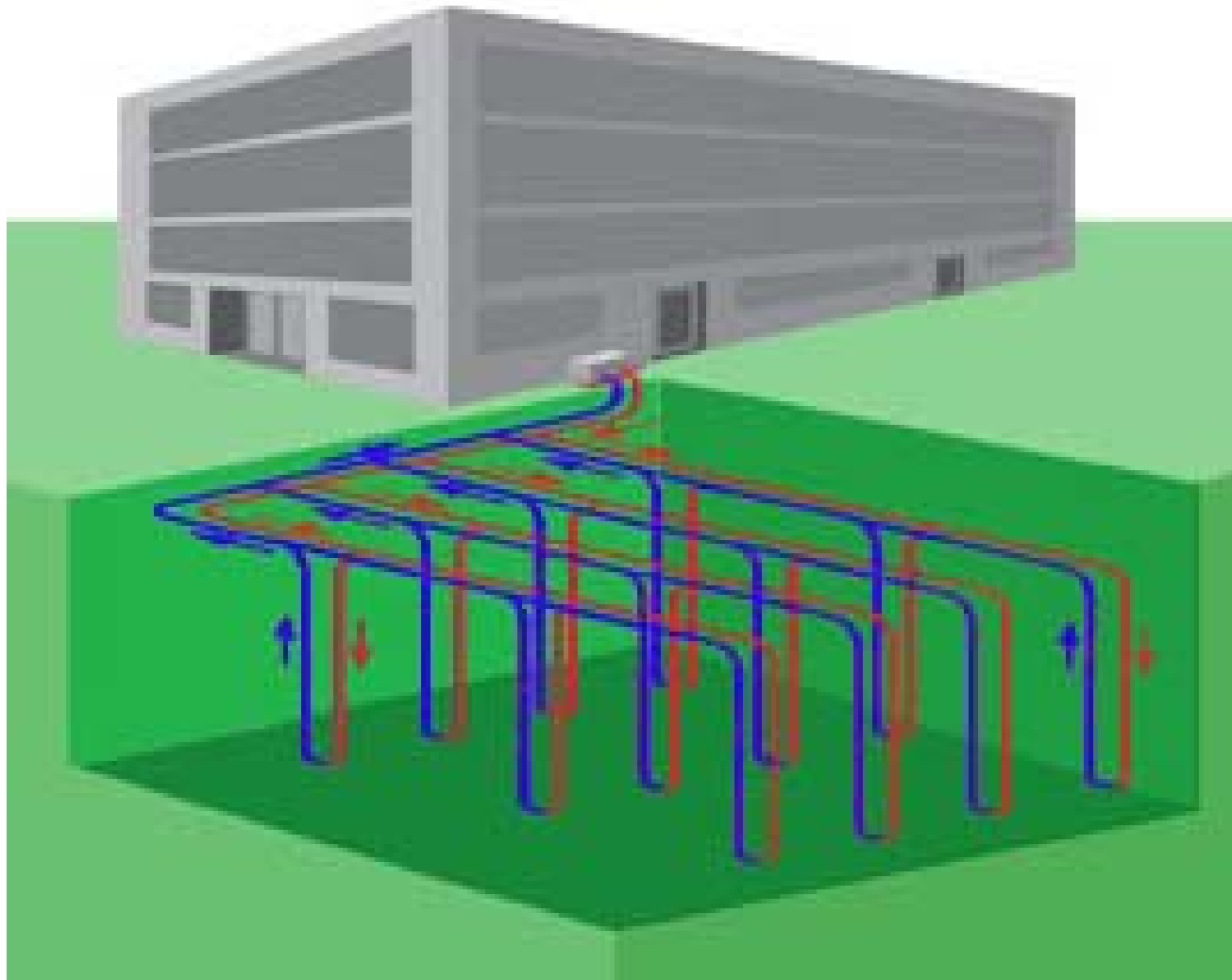


# How a Ground Source Heat Pump Works for Commercial Buildings



# Geothermal avoids the need for outdoor equipment...



..reducing vandalism and liability

Image courtesy of Climate Master



# Why geothermal heat pumps?

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City Center, Corcoran City, Mn



FarmTec Supply, Dyersville, Iowa

- **Free** and renewable source of stored energy...ground.
- **Savings** up to 70% for heating, cooling, and hot water
- **Quiet** and Enhanced Comfort
- **Reliable** and Environmentally Friendly

# Installed Geothermal Heat Pumps



**Holy Cross Lutheran Church, Maple Lake, Mn**



**Metropolitan Housing Trust  
HQ Raleigh Sq Nottingham UK**



**Martin Kroencke & Sullivan John Deere Dealership, Quincy, Ill**

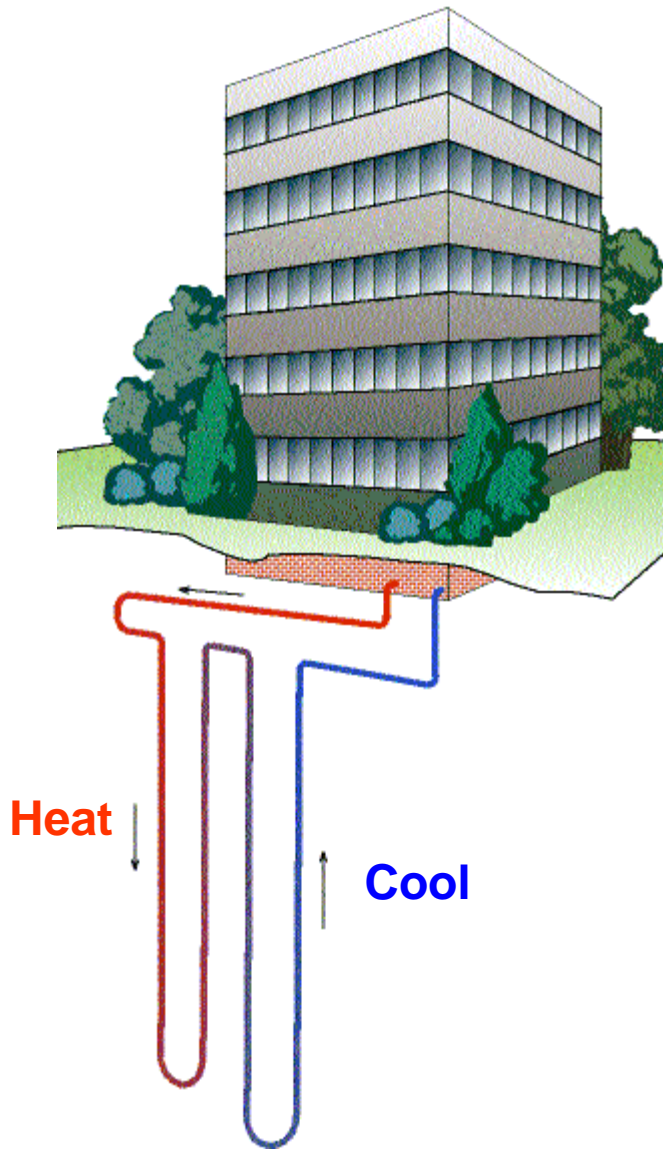


# Benefits-Geothermal Heating and Cooling



- 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



- 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

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Little Red School House  
Onamia, Minnesota  
80,000 sf, Built in 1992  
560 Boreholes, depth  
of 50 feet each, 230 Tons  
Cooling Capacity

- 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

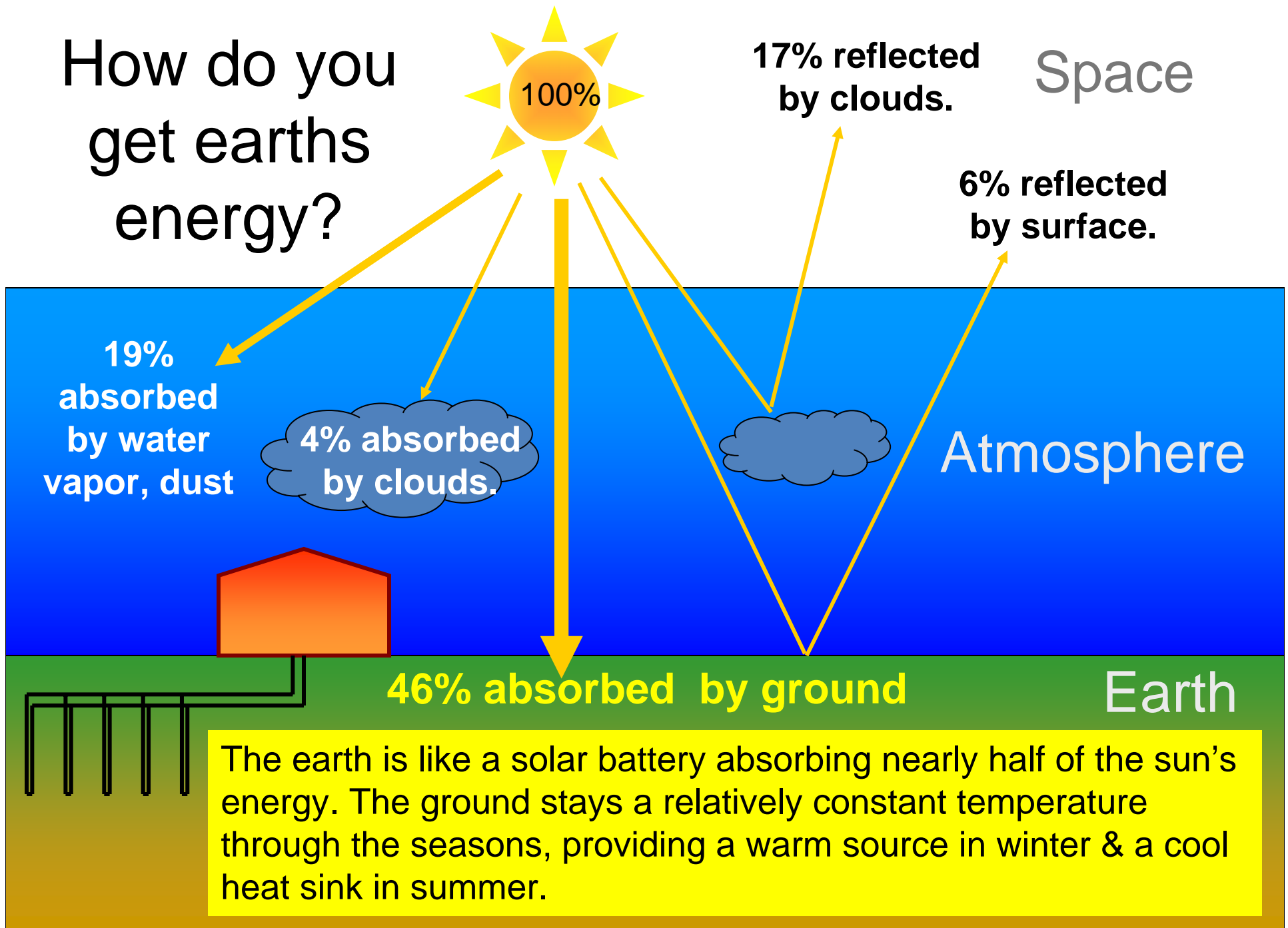


Eliminate cooling tower

- **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?

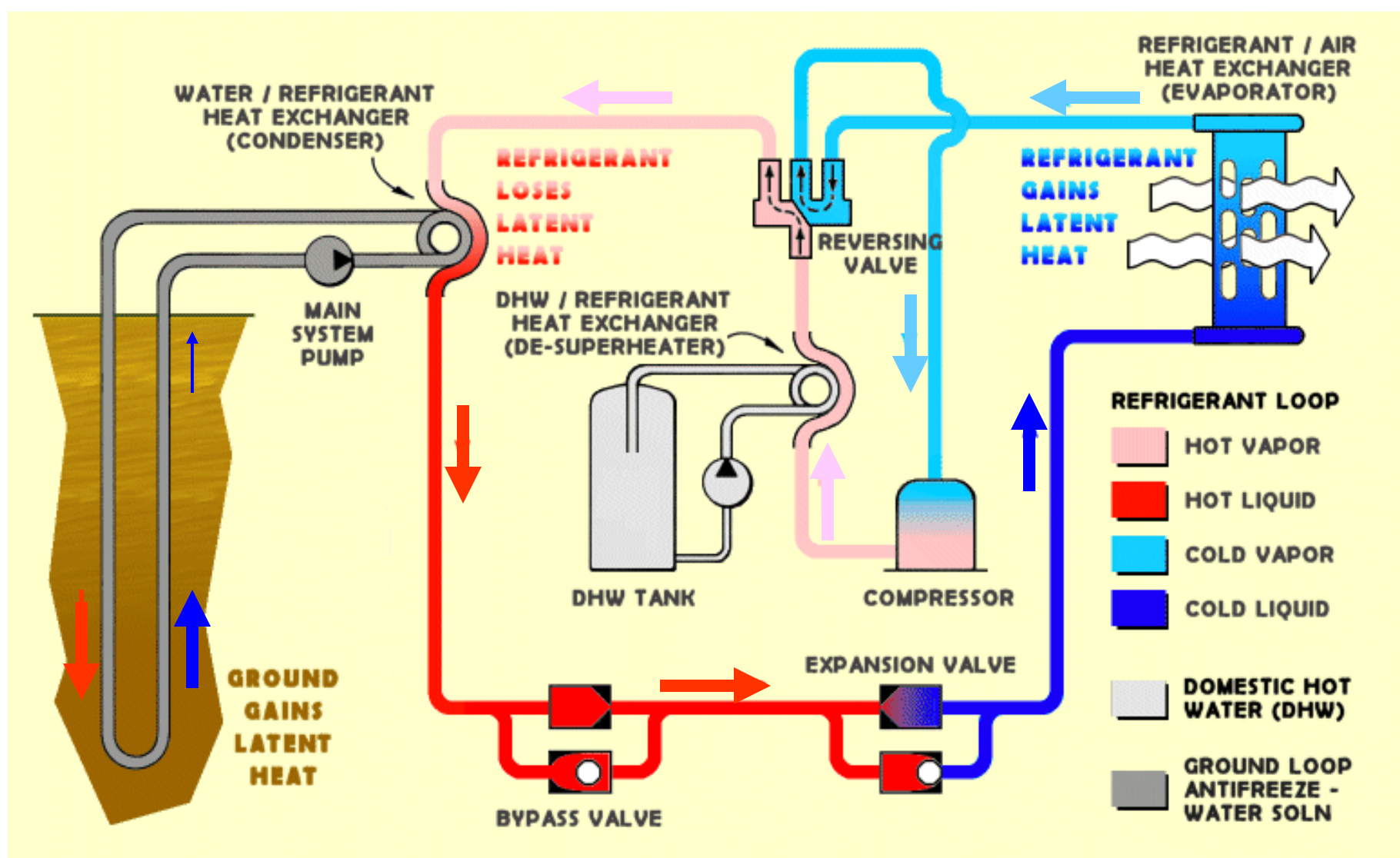


# How do you get earths energy?

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- 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.

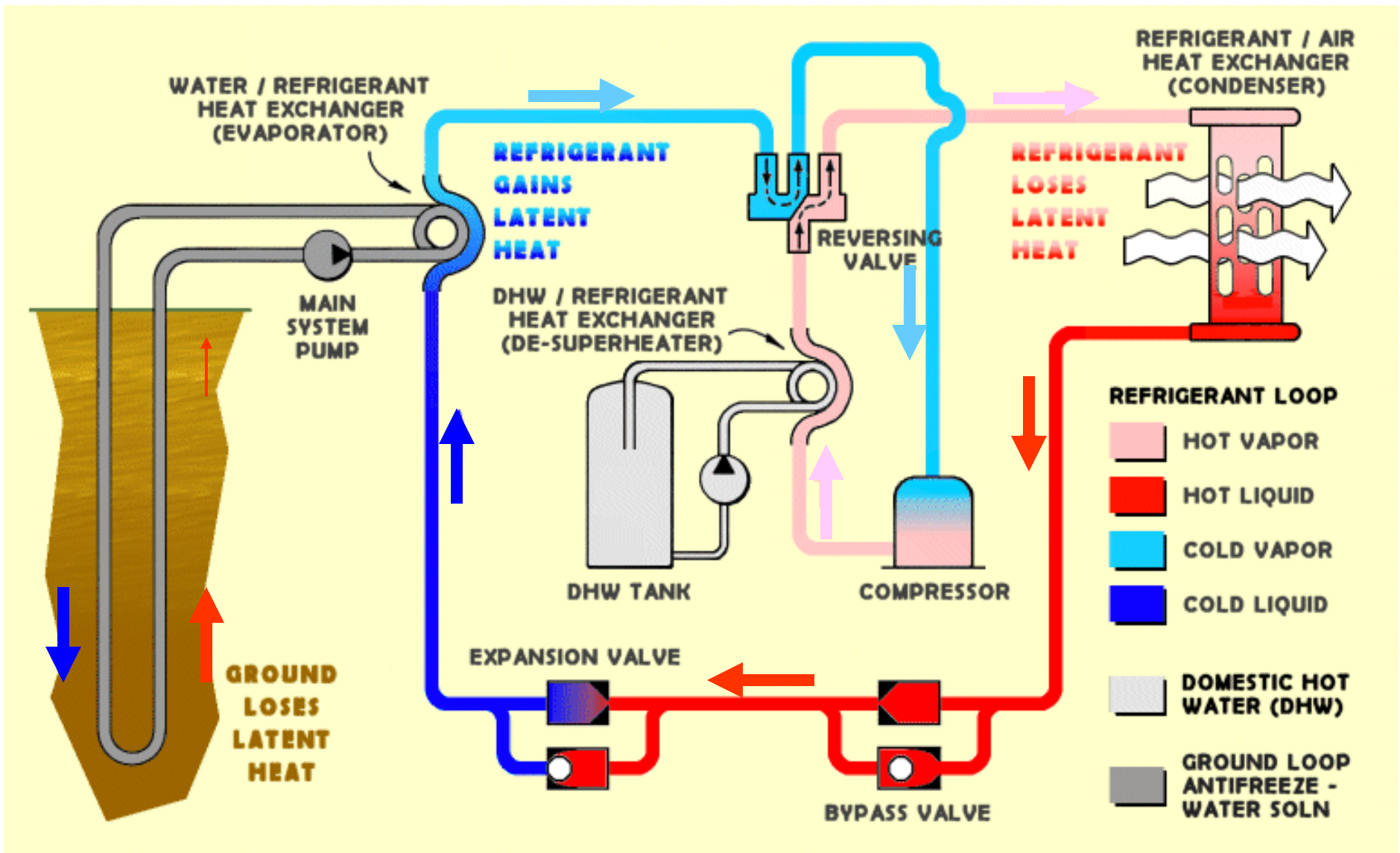
# How the earth works to save you energy! **Cooling**



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**

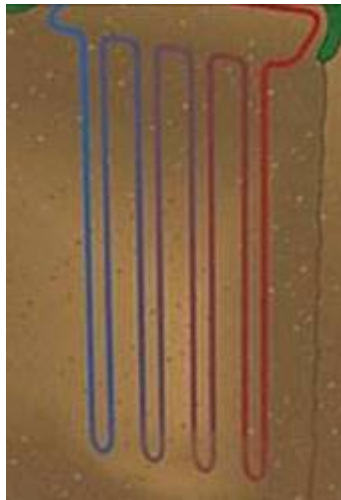


Geo4VA - This is a Special Energy Project funded by the U.S. Department of Energy's State Energy Program through the Virginia Department of Mines, Minerals, and Energy.



# Parts of a Ground Source Heat Pump System

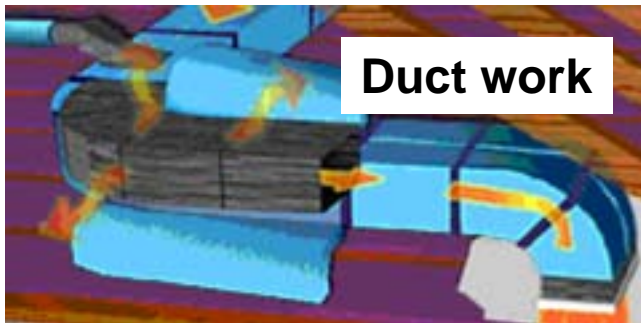
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Ground Loop



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**

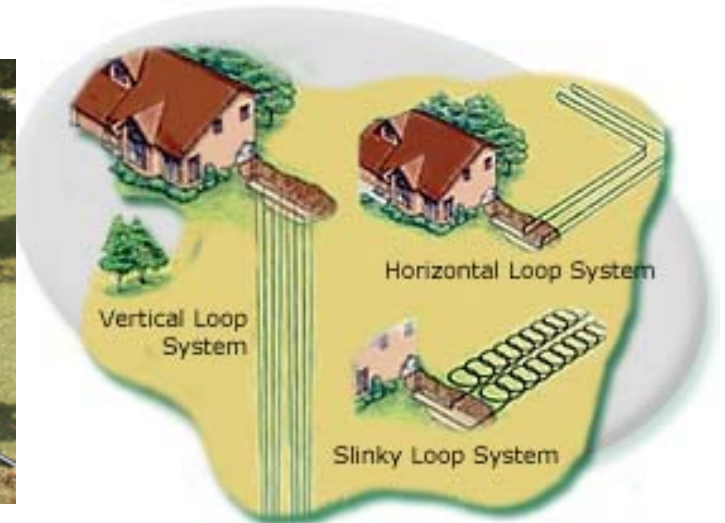
- Trenching-horizontal loops with one or more pipes in loops. 4'-6' deep.
- Or Vertical Boring – vertical loop bore hole with one pipe down hole looping back to surface. Restricted space.
- Or Directional Boring - horizontal loop that can be under a building (limited space).



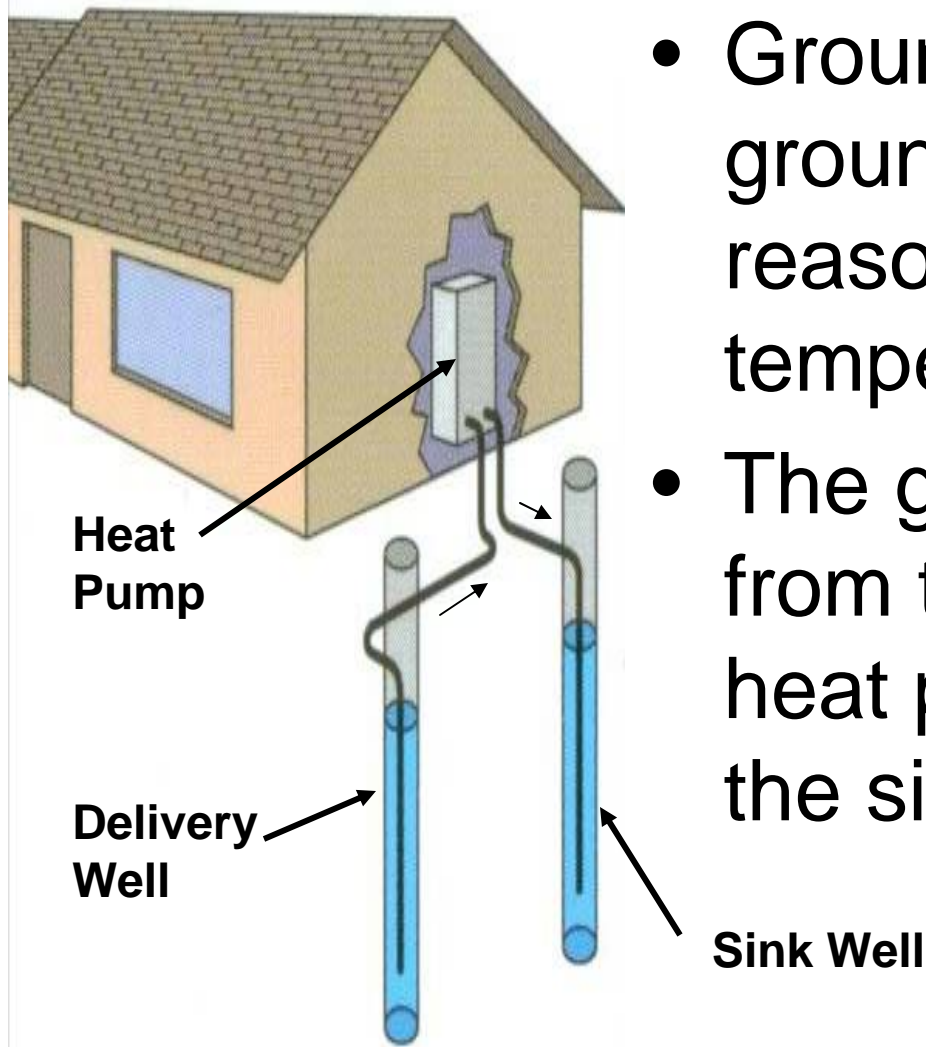
**Vertical Boring**



**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.

# Lake or Pond Closed Loop System

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Image courtesy of  
McQuay International

- 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.



# Chiloquin Community Center 2003



- Southern Oregon, East of Cascades
- Art Gallery, Library, Meeting Hall, Sherriff Dept
- 13,000 ft<sup>2</sup> single story, Radiant floor H/C
- 16 Vertical Boreholes 300 ft deep
- Annual HVAC Energy Use  
5.8 kWh/ft<sup>2</sup> = \$5,350 \$.41/ft<sup>2</sup>

# Several Heat Pumps within Building

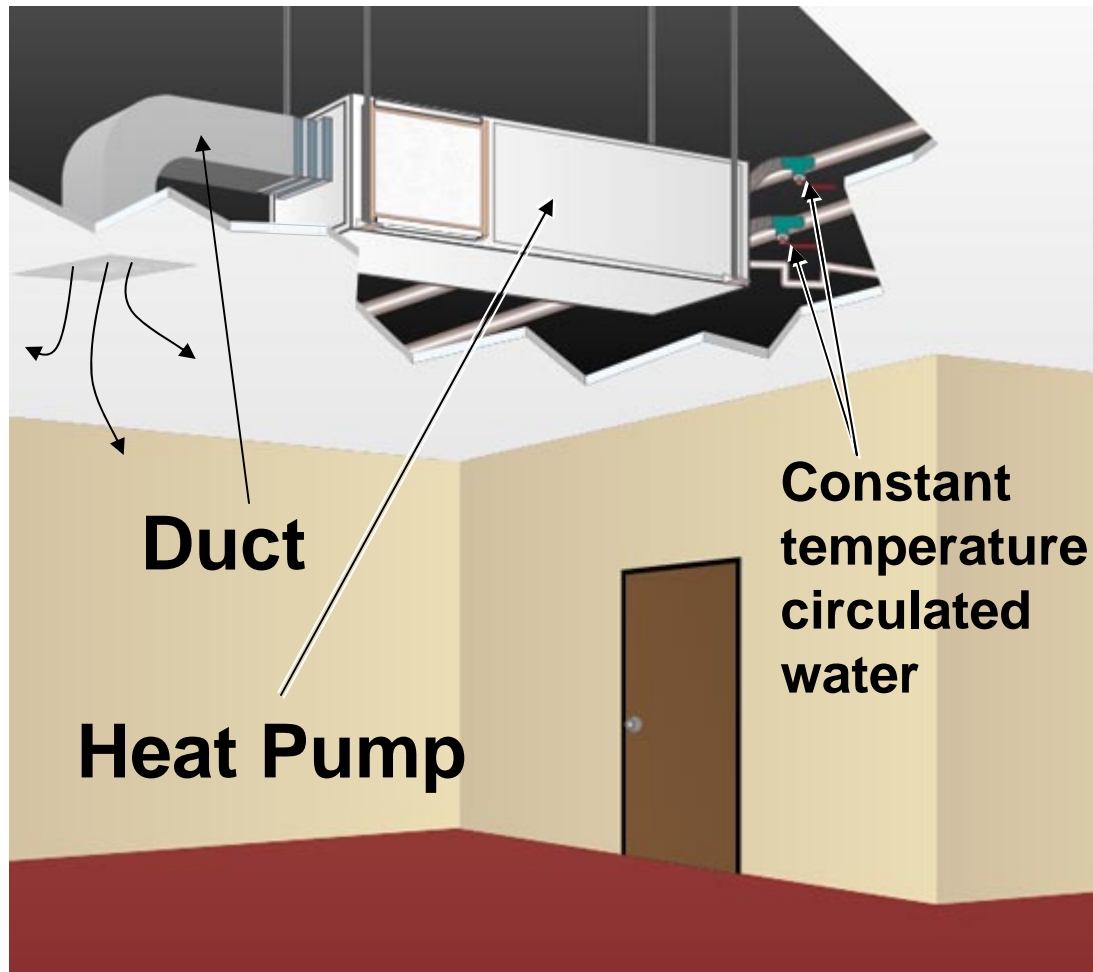
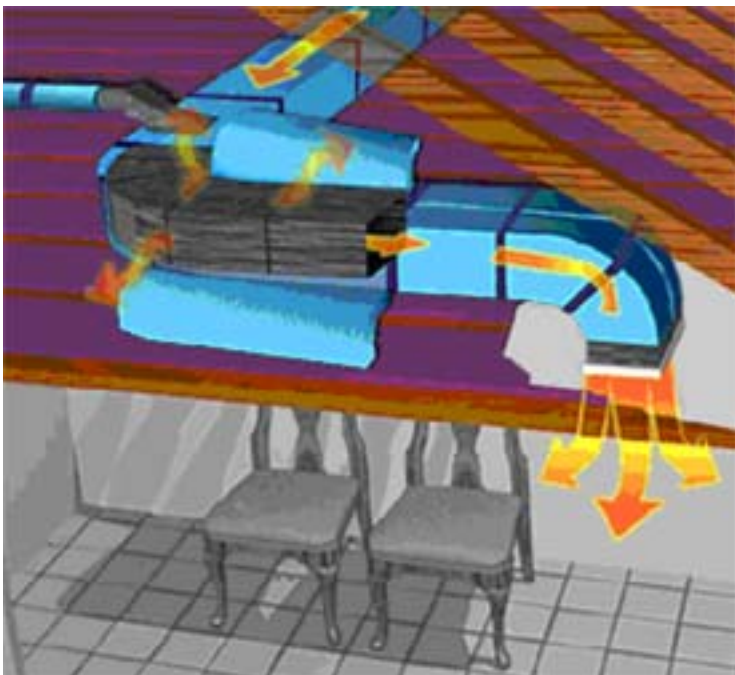


Image courtesy of Climate Master

- 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



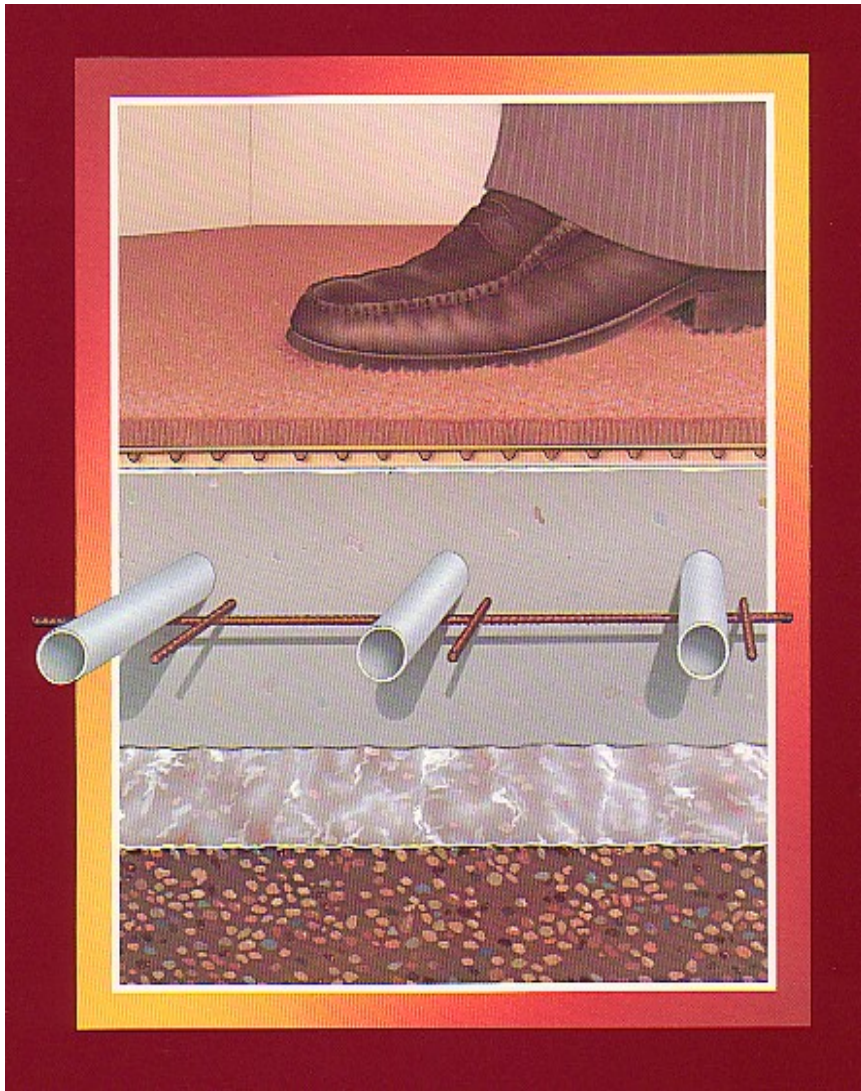
- Warm or cold air blown through ducts
- Zone Control and/or Remote Master Control (one room heating and another room cooling)
- Outstanding Comfort



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

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- 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:

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- The current impact 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.

# The Emergency Economic Stabilization Act of 2008, H.R. 1424

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- The bill extends tax incentives for homes and commercial buildings that support the installation of highly-efficient heating, cooling, and water heating systems, such as geothermal heat pumps until the year 2016.
- Tax credit for residences \$2,000 maximum
- 10% Tax credit for commercial installations.
- To qualify, the systems must meet or exceed EnergyStar requirements and be installed after December 31, 2007.

<http://financialservices.house.gov/essa/essabill.pdf>

# Ground Source Heat Pumps\*

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- 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:

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**McDonald's-Pensacola Florida**  
**Owned by John and Susan O'Connor**  
**Geothermal Heat Pumps**

**55 boreholes 350 deep**

- 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> 