

Heat Pump Technologies Road Map

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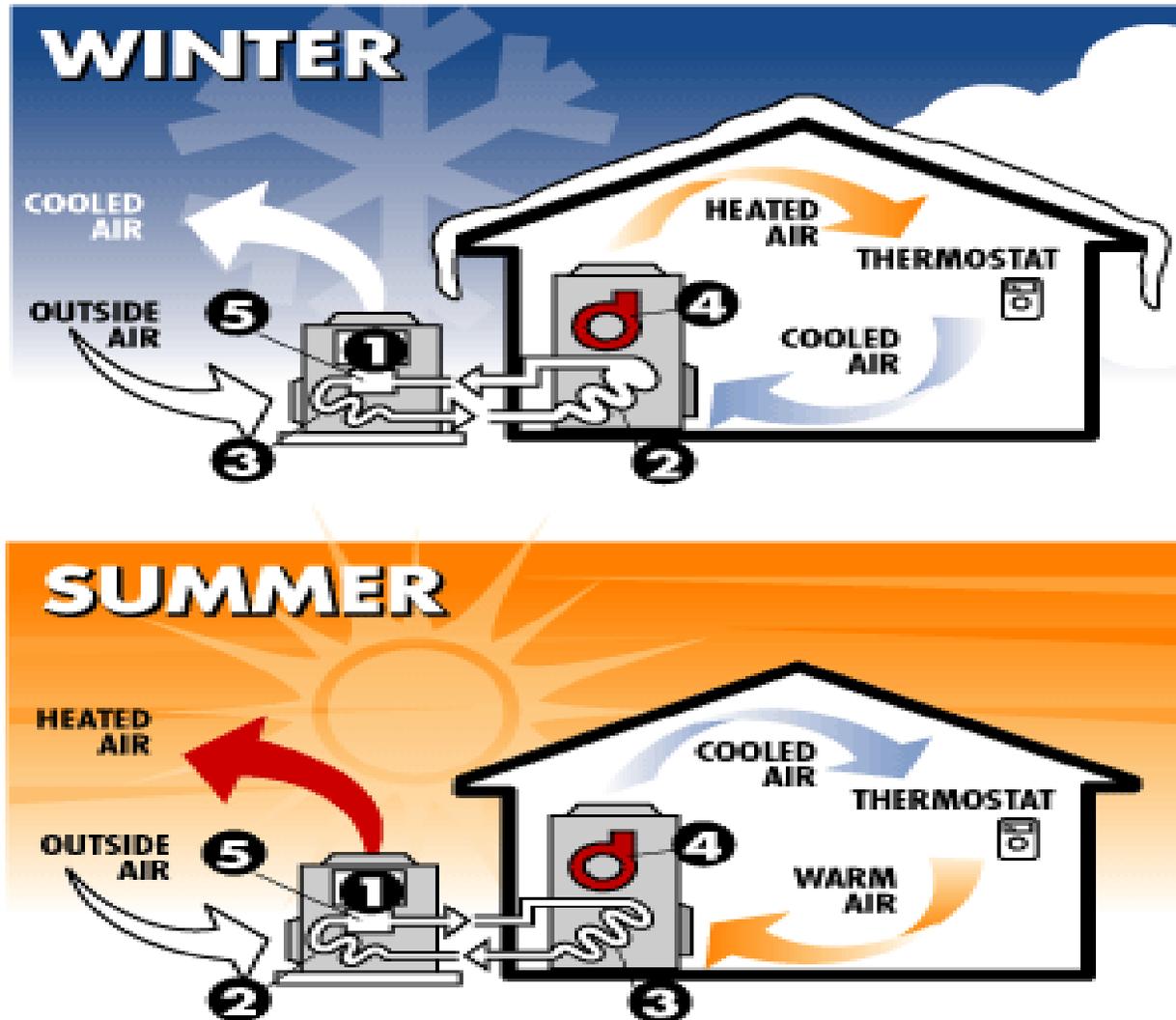


Air Source Heat Pumps

Air Source Heat Pumps

- A heat pump moves heat rather than converting it from a fuel, like in combustion heating systems.
- When properly installed, an air-source heat pump can deliver one-and-a-half to three times more heat energy to a home than the electrical energy it consumes.

How Heat Pumps Work



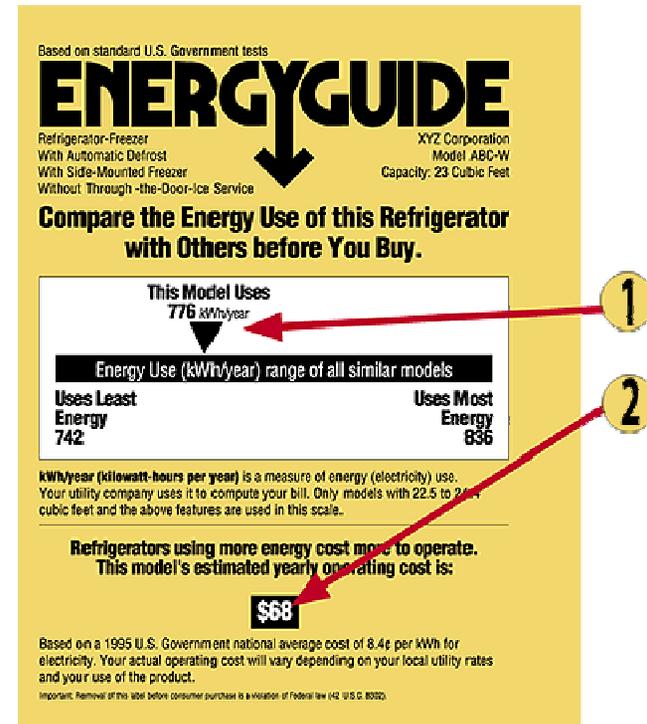
Ideal Climate Zones for Heat Pumps

- Don't generally perform well over extended periods of sub-freezing temperatures.
- In regions with sub-freezing winter temperatures, it may not be cost effective to meet all heating needs with a standard air-source heat pump.
- However, new systems with gas heating as a backup are able to overcome this problem



EnergyGuide Label

- As of 2006, the U.S. DOE established a new standard requiring central heat pumps to have a minimum rating of 7.7 HSPF.
- Warmer climates: SEER is more important than HSPF
- Colder climates: focus on getting the highest HSPF feasible.



Factors to Consider Purchasing/ Installing Air Source Heat Pumps

- Select heat pump with demand-defrost control.
- The heat pump coil should usually be placed on the cold (upstream) side of the furnace for greatest efficiency.
- Fans and compressors make noise. Locate the outdoor unit away from windows and adjacent buildings, and select a heat pump with an outdoor sound rating of 7.6 dbels or lower.
- Outdoor units should be protected from high winds, which can cause defrosting problems.

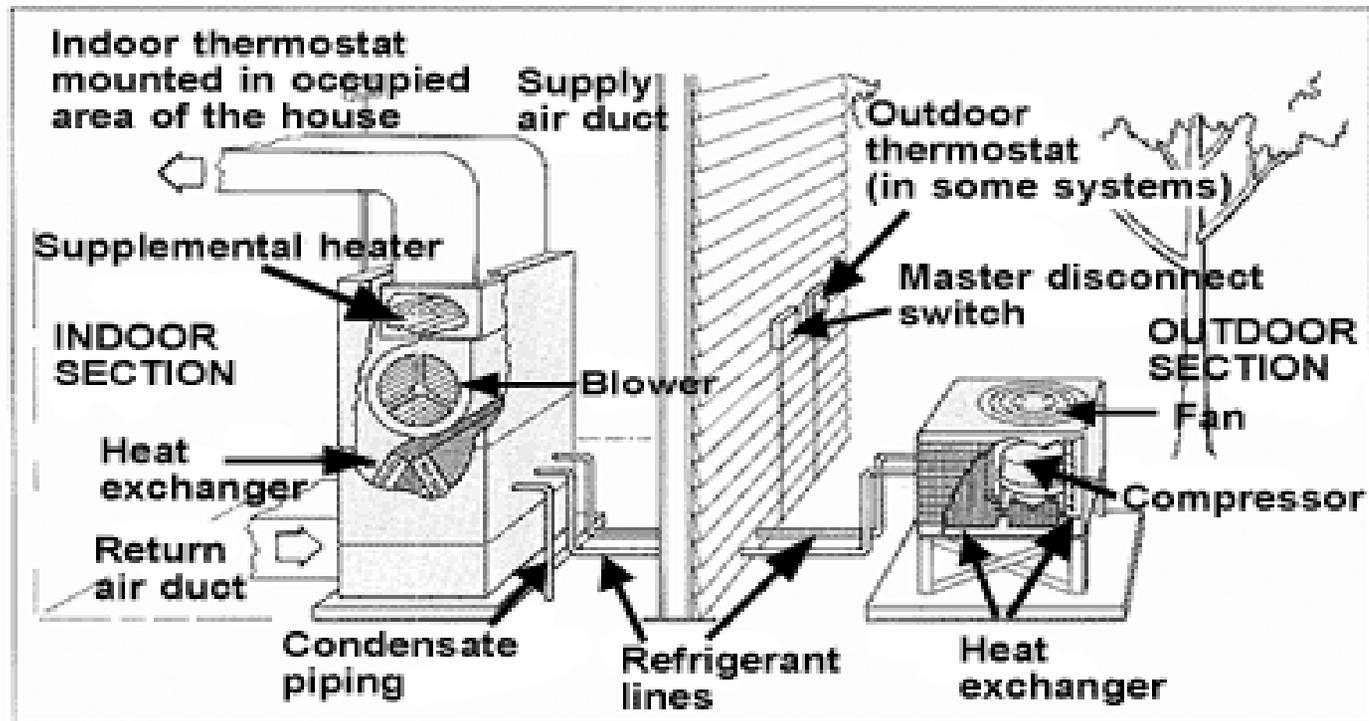


Dual Fuel Heat Pumps

Dual Fuel Heat Pumps

- An air-source heat pump designed to be installed and to work with a forced air furnace heating system.
- The forced air furnace can be new or existing, and can be fueled with natural gas or propane.
- The hybrid heat pump heat pump works in conjunction with the existing furnace, regardless of fuel type.

Diagram of Dual Fuel Heat Pump



Costs and Savings

- A hybrid unit costs about \$600 - \$2,000 more than conventional heating and cooling systems.
- However, this higher cost can be offset by the energy savings.
 - a heat pump can reduce a member's energy bill by 60 to 70 percent.

Ideal Climate Zones for Dual Fuel Heat Pumps



- Dual-fuel heat pumps are effective in regions where winter temperature is usually above freezing (*allowing heat pump to be used much of the time*) but can occasionally drop below freezing, when the gas furnace provides heat more economically.
- Combining the two offers the benefits of both systems. However, the system needs to be set up so that the heat pump is used whenever possible as it will operate at a fraction of the cost of the gas furnace.

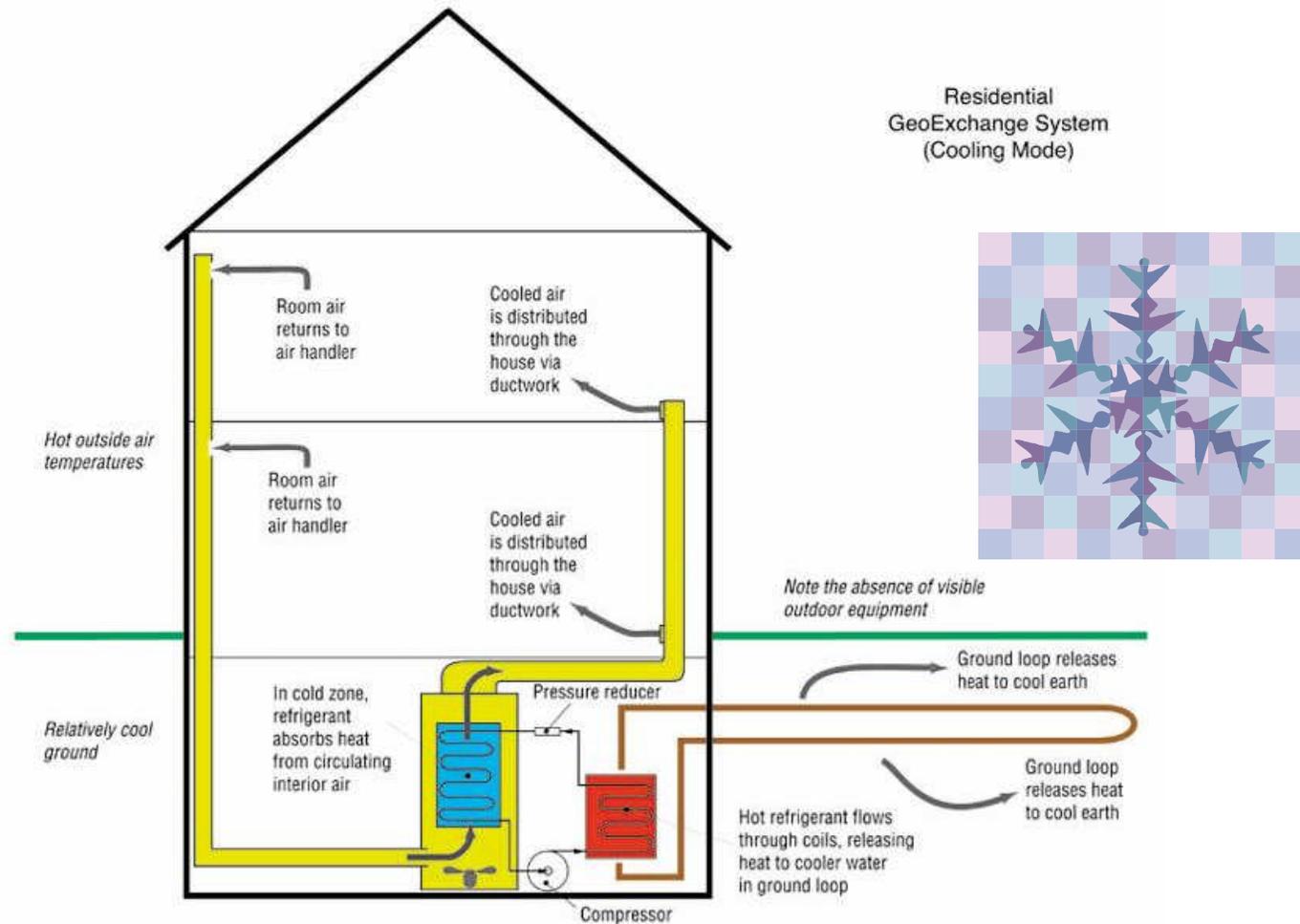


Geothermal Heat Pumps

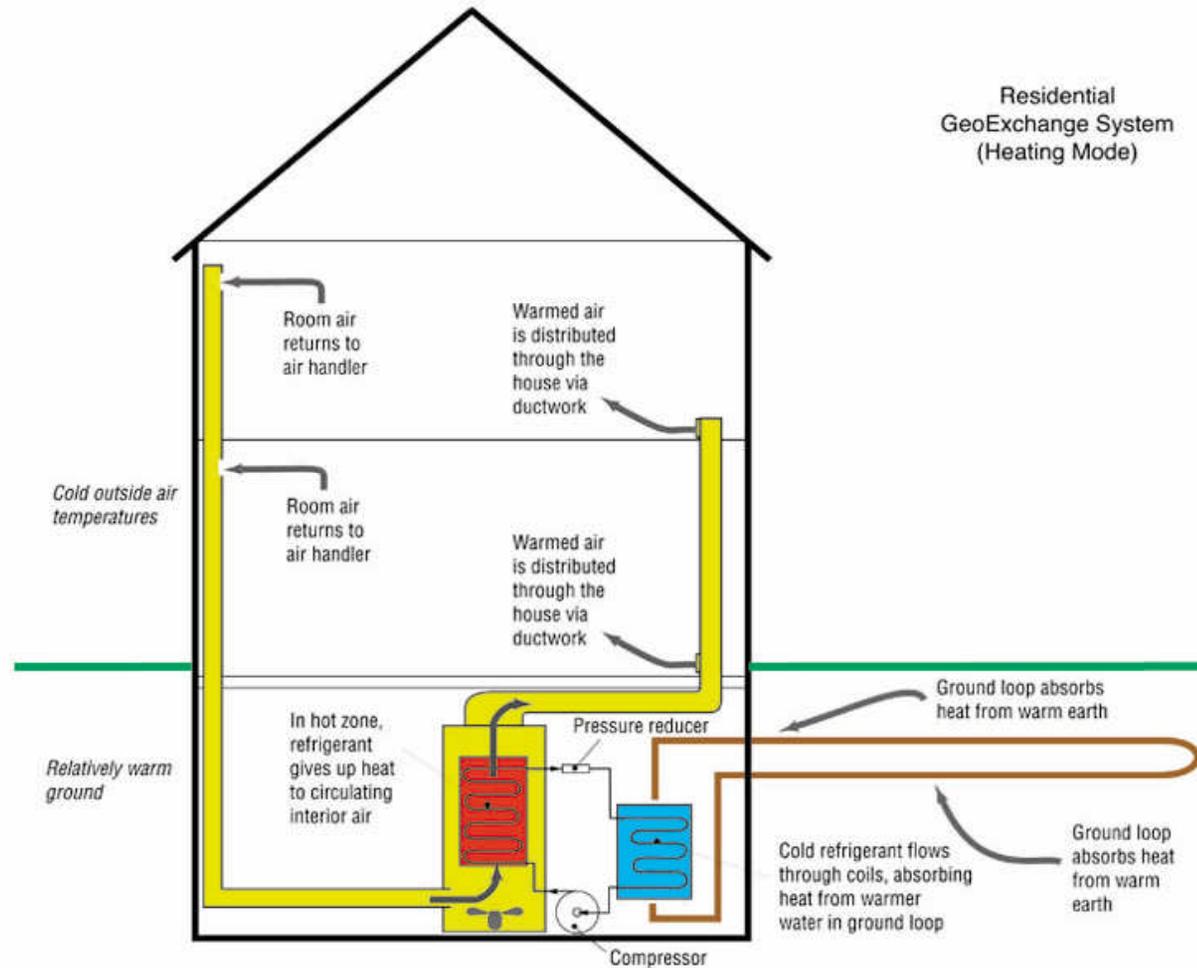
GHP Overview

- Approximately 1 million ghps are installed in US.
- Significant energy savings and reductions in carbon emissions:
 - Elimination of more than 6.2 million metric tons of CO₂ annually
 - Annual savings of more than 7 billion kWh
 - Annual savings of more than 36 trillion BTUs of fossil fuels
 - Reduced electricity demand of 2.3 million

GHPs in Summer



GHPs in Winter

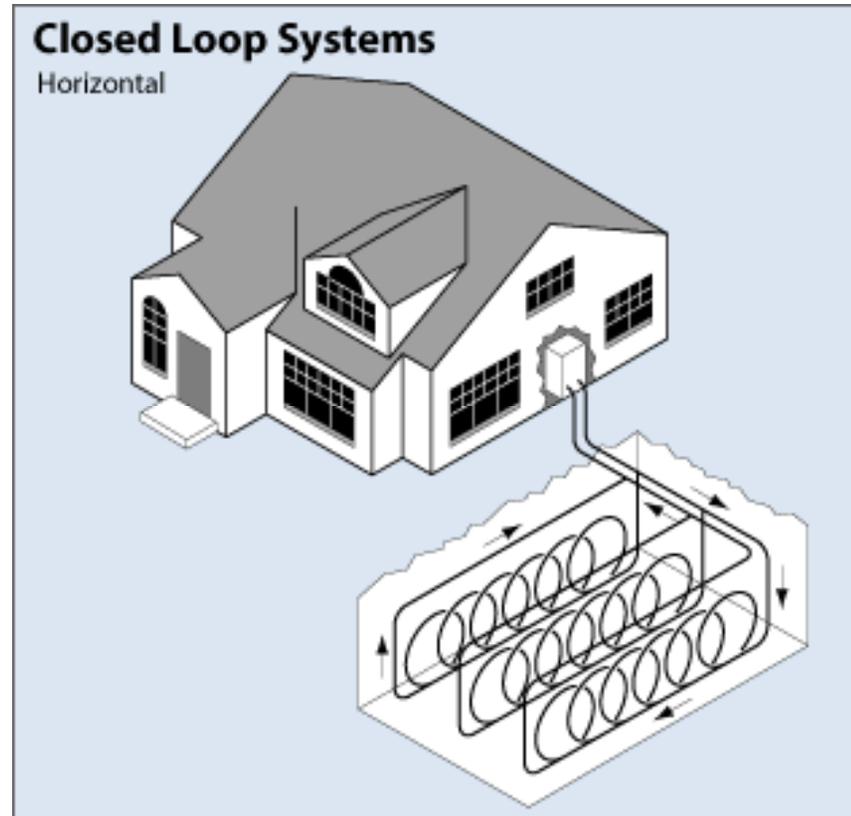


Types of Installations

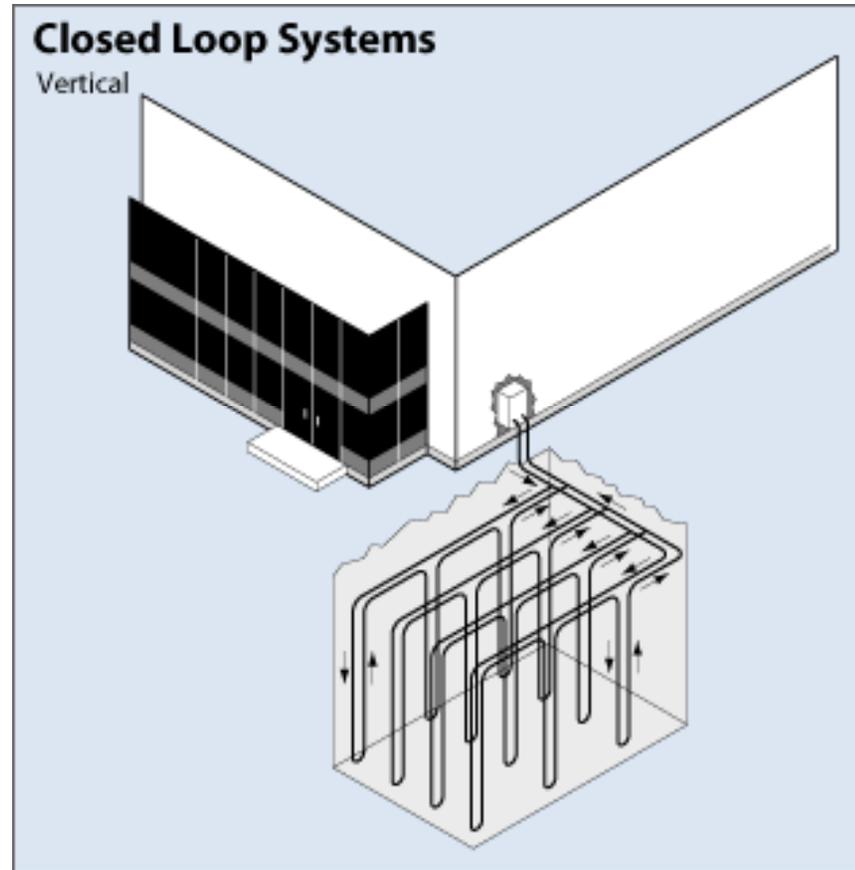
- Closed Loop
 - Horizontal,
 - Vertical, and
 - Pond/lake
- Open Loop

All can be used for residential and commercial building applications.

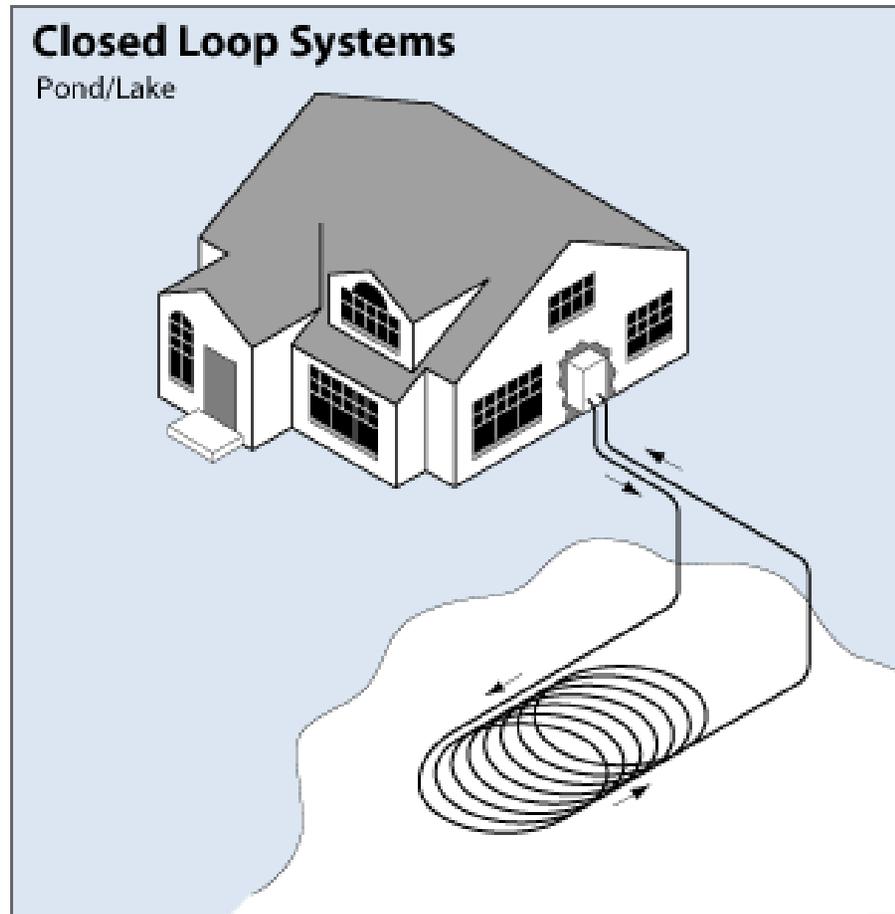
Closed Loop System



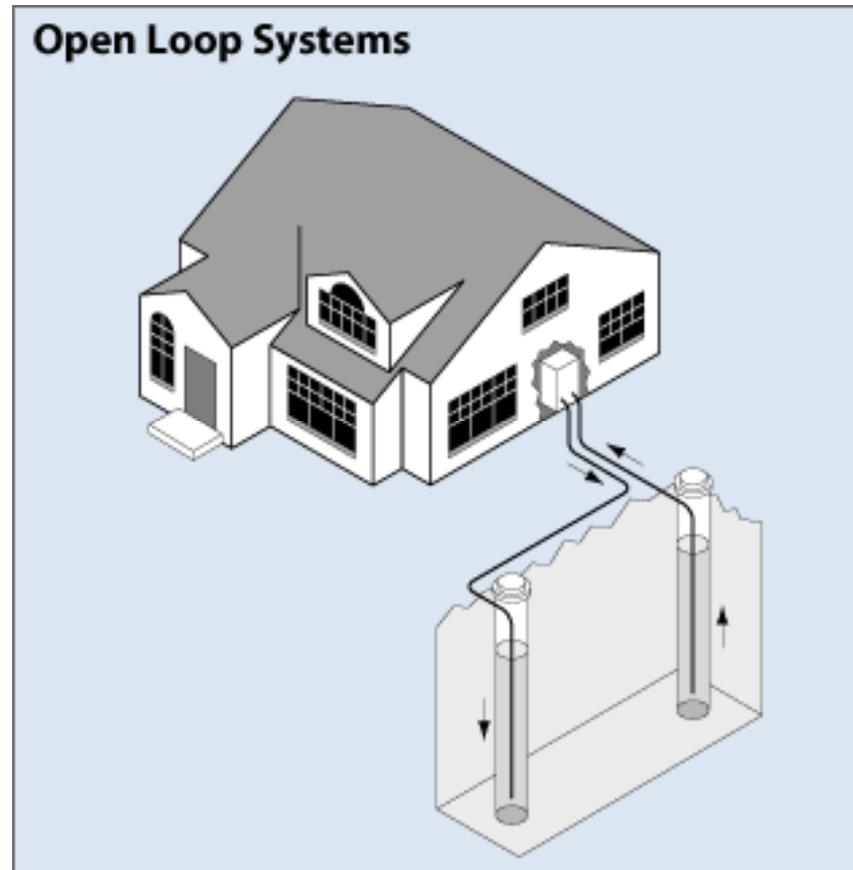
Closed Loop System



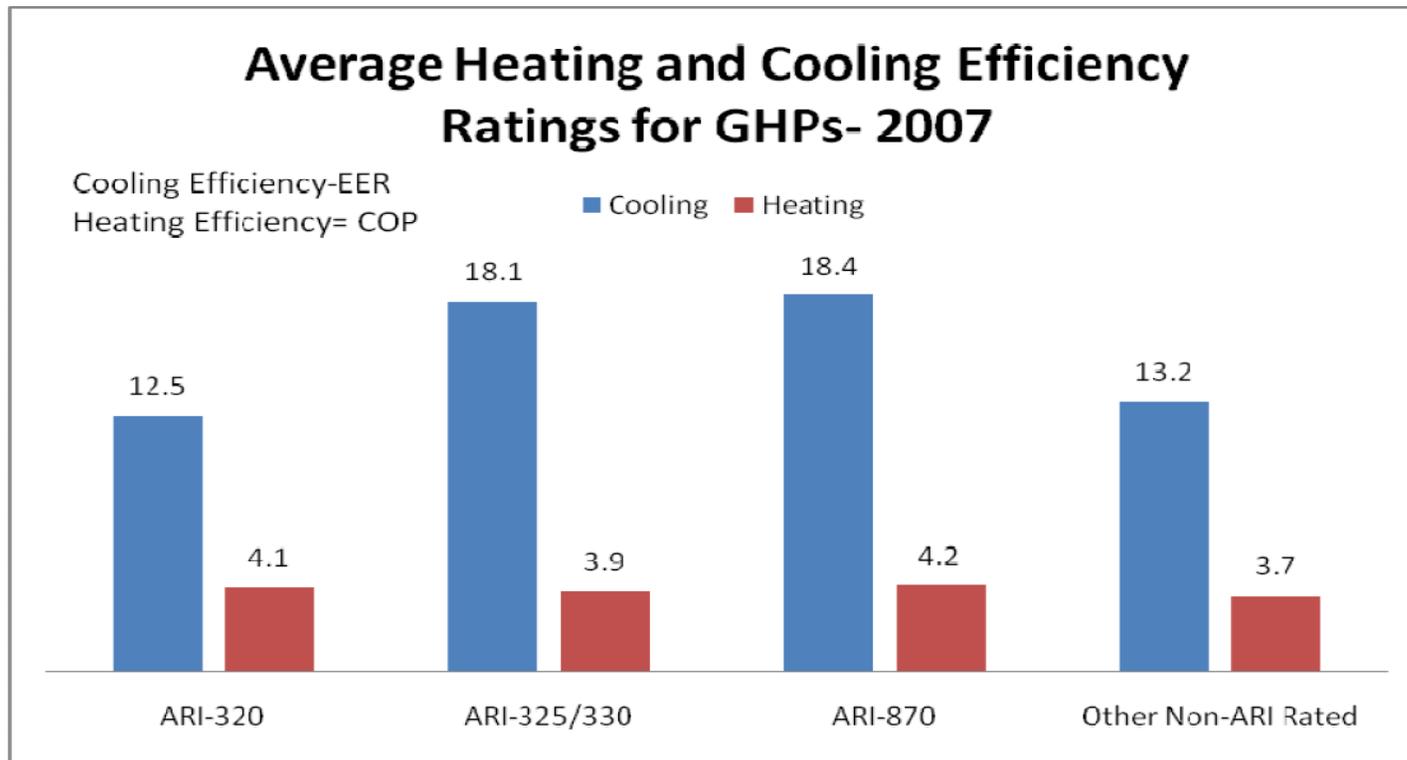
Pond/Lake Installation



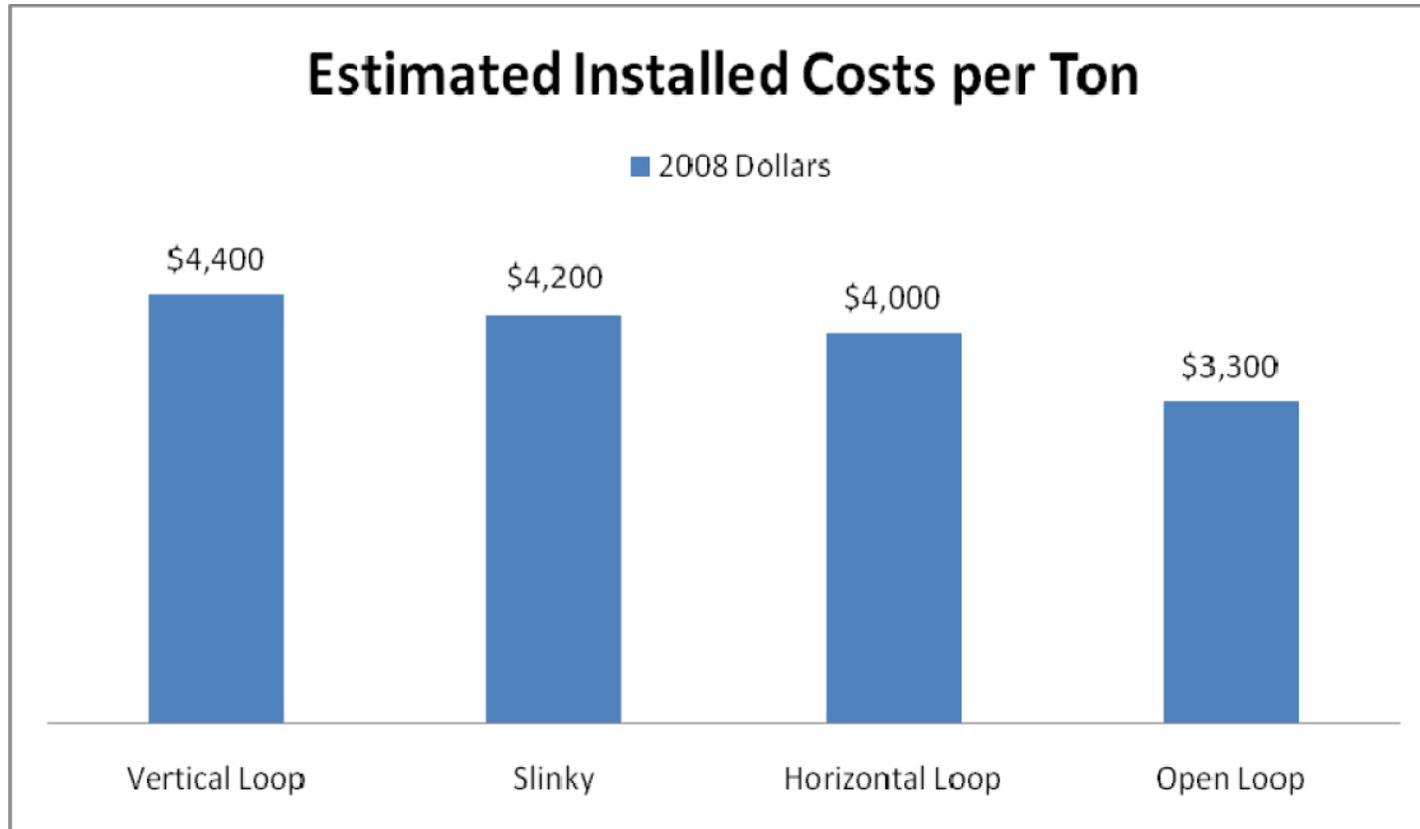
Open Loop System



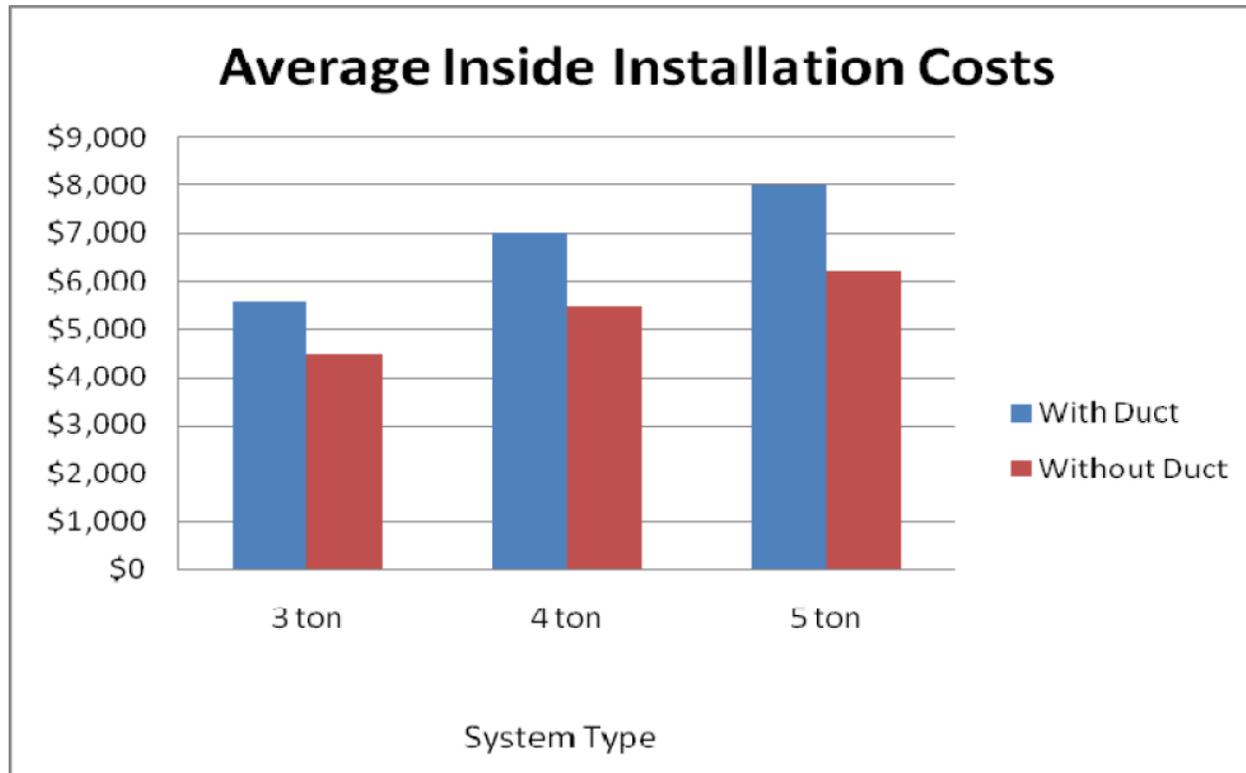
Efficiency Levels for GHPs



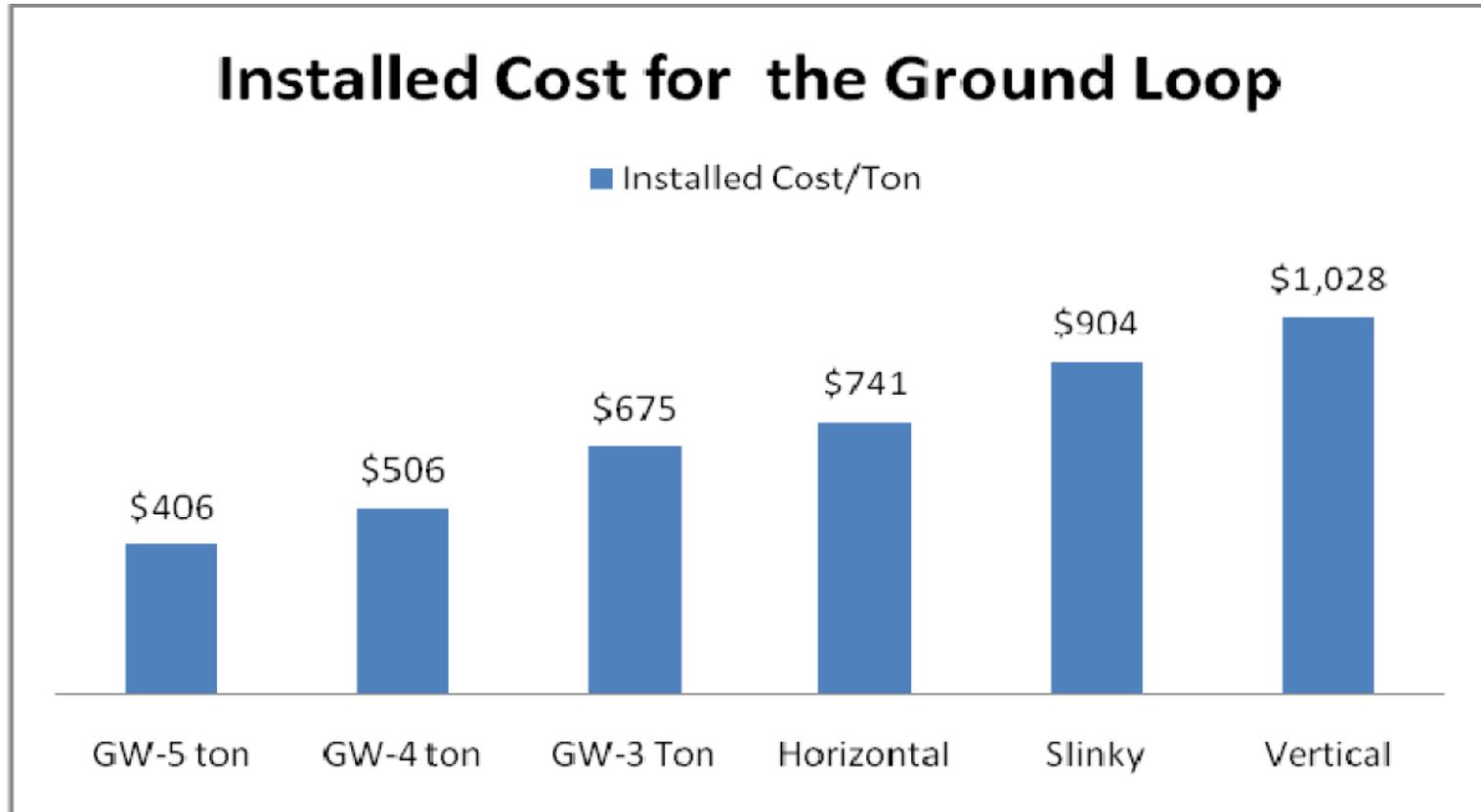
Estimated Costs per Ton for GHPs



Average Installation Costs



Average Installed Cost for Ground Loop



Benefits to Customers

- ***Substantial cost savings:*** Geothermal heat pump systems can save as much as 50% compared to air-source heat pumps and up to 45% over fossil-fuel furnaces.
- ***Economical rates:*** Some utilities offer special, lower winter rates for geothermal heat pump customers.
- ***Environmentally Friendly:*** These systems are a “renewable” energy source that encourages conservation of natural resources.
- ***Financing:*** Some utilities offer financing through either private financing or utility-sponsored loop leases.

Benefits to Utilities

- Energy efficient technology that
 - Builds profitable off-peak load
 - Provides a competitive response to natural gas and propane
 - Offers customers a choice, and
 - Provides a potential opportunity to control air conditioning and water heating loads in the future.