

# Geothermal Heat Pump Systems



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# Types of Heat Pumps

- **Air Source heat pump (air to air) operates in two basic modes**
  - As an air conditioner. A heat pump's interior coil extracts heat from the building interior, then pumps the heat to the coil in the outside unit where it is discharged to the air.
  - As a heating device. The heat pump's outdoor device extracts heat from the outside air and pumps it indoors where it is discharged into the building.
  - PV=NRT
  - Typically used in residential applications
  - Requires backup heat source



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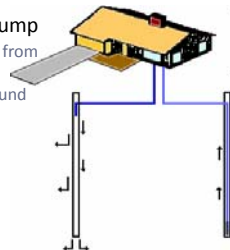
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# Types of Heat Pumps

- **Open Loop Water Source Heat Pump**
  - Supply water is used once and comes from a well, stream or pond
  - Water is discharged back into the ground after being pumped through the heat pump
  - Advantages
    - × High equipment performance
    - × Low initial cost
  - Disadvantages
    - × Water quality may be poor
    - × Lower equipment life
    - × Reliability



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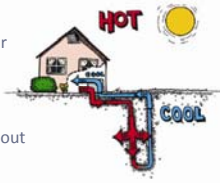
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## Types of Heat Pumps

- **Geothermal Closed Loop Heat Pump (water to air)**

- Transfers heat to/from water, rather than air
- No backup heat source required
- Winter - loop fluid absorbs stored ground heat and carries it indoors. (out at 35°F, back in at 45°F)
- Summer - absorbs heat from the building and carries it through the earth loop and deposits heat in the cooler earth. (out at 85°F, back in at 77°F)



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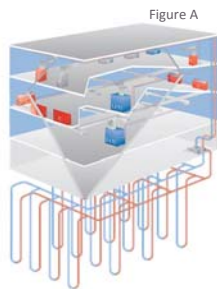
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## Typical System

- **Figure A illustrates the route of fluid in a closed loop geothermal system**



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## Loop Field Construction

- **Loop Field Costs**

- Typically \$6-\$8/ft<sup>2</sup>

- **Contractors**

- Loop Tech 936-295-8704  
Huntsville, TX
- Jensen Well 402-426-2585  
Blair, NE
- K2 Construction 402-467-2355  
Lincoln, NE
- Downey Drilling 308-324-2303  
Lexington, NE
- Leuck's Drilling Co. 402-339-8488  
Papillion, NE



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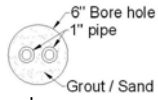
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## Geothermal Loop Field Sizing

- Conductivity test and test bore on site
  - Determines soil quality for heat transfer
    - ✦ Grouting of hole plays large part
- Determine building heating and cooling loads
- Input data into software program
- Determine total bore length required
  - Determine number of holes and depth
- Layout loop field based on 20 ft. centers




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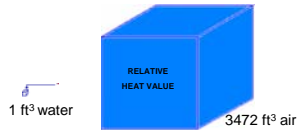
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## Geothermal Efficiency

- Water
  - Stores tremendous quantities of heat. Few substances have a higher specific heat than water.
- Air
  - Very low specific heat.
  - 3472 times more heat stored in a cubic foot of water than a cubic foot of air.




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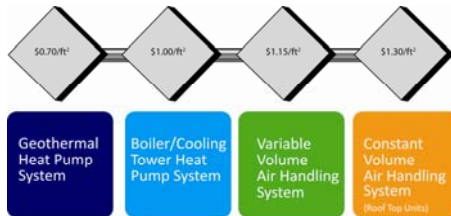
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## Annual Building Energy Cost Comparison




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## Geothermal and the Environment

- Works with nature, not against
- Minimizes environmental impact
  - Use of natural resources
  - Air pollution
  - Greenhouse effect
- Closed continuous loop contains environmental friendly fluid



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## Geothermal Maintenance

- Reduced maintenance
- Periodic check and filter changes are the only required maintenance
- Buried loop lasts for many generations
- Fan, compressor and pump is housed indoors away from outside elements

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## Typical Heat Pump



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## Ventilation Energy Impact

- Fresh air
  - Summer (design day)
    - × 95°F dry bulb (d.b.)/78°F wet bulb (w.b.)
    - × Air needs to be cooled/dehumidified to approximately 55°F
  - Winter (design day)
    - × -10° F
    - × Air needs to be heated to approximately 65 °
  - Requires approximately 35% of your total annual energy used by the HVAC system



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## Energy Saving Alternatives

- Energy Recovery Units
  - Heat wheel
    - × Winter
      - Hot exhaust air moves through corrugated metal wheel with moisture absorbing ability.
      - Recovers heat from both latent (moisture) and sensible energy (air) sources.
      - Wheel rotates to incoming air side and warms air as it passes through the wheel.
    - × Summer
      - Winter process is reversed. Cool exhaust air tempers hot incoming air.



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## Other Energy Saving Alternatives

- Solar energy
- Variable ventilation air flow in building with CO<sup>2</sup>/VOC monitoring
- Geothermal heat sink/source applications
  - In floor radiant heating
  - Pool/process heating and cooling
  - Chiller heat rejection
  - Hot and chilled water systems
  - Hybrid systems



Solar Panel



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