Geothermal Done Right
Renewable Energy

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What will be discussed in this session?

Key applications, components and challenges of every geothermal system.

Types of energy extraction loops and installation methods.

System performance vs alternatives.

Financial Evaluation “Do the Math”.

Example of installation with Geothermal.

Where is the future of geothermal.
81%

Of people who expect to buy a new home in the next two years say higher energy efficiency would cause them to choose one new home over another.
Department of Energy Goal

Our Vision: Every home & building in America is energy responsible and sustainability is ordinary
Key Components to Achieve a Successful Geothermal System

- Geothermal Heat Pump
- Energy Delivery System
- Geothermal Earth Loop
- Liquid Loop Heat-Exchange Medium
- Qualified Installing Professional
- Qualified Designing Professional
Interesting Facts

According to the Environmental Protection Agency (EPA), GeoExchange technology is the most energy-efficient, environmentally-clean and cost-effective space conditioning system available.

Federal Tax Credits (residential) currently in place allows for a 30% tax credit through December 2016.
What Is Geothermal Energy?

“Geothermal”-- Heat from the earth
Normal earth temperatures
Earth absorbs 47% of the sun’s energy
that reaches it
Available everywhere
Not associated with geysers
The earth can absorb nearly half of the sun’s energy. The ground stays a relatively constant temperature through the seasons, able to absorb the rejected heat in summer and release this heat stored back in the winter.
Earth Temperatures

- A few feet below the surface, earth temperatures remain relatively constant and moderate.
- Ground temperatures are much milder than average monthly air temperatures.
VALUES OF MEAN ANNUAL EARTH TEMPERATURE FROM OBSERVATIONS AT INDIVIDUAL STATIONS ARE SUPERIMPOSED UPON COLLINS' ESTIMATED (1925) WELL-WATER ISOHERMS.

FIGURE 4.17: Mean Earth Temperature, $T_M$ ($^\circ$F)
Energy Source

During the heating season, the earth serves as a heat *Source*. (HE - Heat of extraction)

During the cooling season, the earth serves as a heat *Sink*. (HR - Heat of rejection)
Ground Source Heat Pumps

Heat pumps “move” energy from one location to another, instead of creating heat by burning fossil fuels, such as a gas furnace does. -- (like your refrigerator).

Geothermal Heat Pumps use the earth or well water to provide heating, cooling and hot water for your home.
Ground Source Heat Pumps

The heat moves through a liquid medium inside a loop system (Closed Loop) or through well-water (Open Loop)
Heating Operation

Water Heater

Hot Water to House

Return Air Duct

Cold Water to Unit

Supply Air Duct

Air Coil

Blower

Water to Loop

Pump

Water from Loop

Earth Loop- Horizontal, Vertical, Pond (or Well Water)

Key: Red indicates warm/hot. Blue indicates cool/cold.
The Second Law of Thermodynamics

Energy (heat) flows spontaneously from an area of high concentration (hot body) to an area of low concentration (cold body).

Always hot to cold, never cold to hot

Cooling is actually the removal of heat
Loop System Materials

High Density Polyethylene
Flexible
Heat Fusion Capable
Socket
Butt
Loop System Types

Closed Loop (w/ antifreeze)
  Horizontal
  Vertical
  Pond
Open Loop
  Well Water
Horizontal and Vertical
Individual Channel Loop Installation
Vertical Bohr Installation
U-BEND at Bottom of Bohr
Grout inserted from bottom to the top of Bohr.
Directional Bohr Loop Installation
**Pond Loop**

Requires minimum of ½ acre private land
9 feet deep at most shallow season of the year
HDPE Loop Pipe Benefits

• High density polyethylene pipe (life expectancy of over 200 years)
• Does not rust, rot, or corrode
• All connections are made by heat fusion
• 50 Year No Leak Pipe warranty
Equipment Performance Ratings

ARI has designated the efficiency ratings for water-to-air heat pumps as:

**Energy Efficiency Ratio (EER)**

$\text{EER} = \frac{\text{BTU output}}{\text{power watt input}}$
For cooling operation under steady state test conditions

**Coefficient of Performance (COP)**

$\text{COP} = \frac{\text{BTU output}}{\text{BTU input}}$
For heating operation under steady state test conditions
Cooling Performance Ratings

Geothermal: 17-41 EER
Air Source Heat Pump: 10-15 EER
Air Conditioner: 10-15 EER
Heating Performance Ratings

Geothermal (ground source) 3.5-6.0 COP
Air Source Heat Pump 1.8-2.0 COP
Fossil Fuel Furnace 0.80-0.95 COP
Electric Furnace/Baseboard/Ceiling Cable 1.00 COP
Geothermal Water to Air 5 ton system
- 3 thermostat control zoning
- Domestic hot water desuperheater
Geothermal Done Right!

Requirements of HVAC Designer / Contractors:

1. ACCA Manual J (or Automated) Load Calculations
   Appliance Heat Gains
   Solar Heat Gain / Loss
   Occupancy Heat Gain
   Infiltration Rates and Building Envelope

2. ACCA Manual S (or Automated) Duct Calculations
   Duct gain or Loss
   Energy Flow and Distribution
Geothermal has come a long way from the days of ignition and combustion.

With Geothermal both comfort and efficiency are built directly in.
Questions?