Geothermal Heating and Cooling Systems 101

Chris Butts, President, Perfect Temp Geothermal

PERFECT TEMP
HEATING • COOLING • GEOTHERMAL

Geothermal Heating & Cooling

- What It Is
- How It Works
- Benefits
- Geothermal and Net Zero Buildings
- Tax Credits and Rebates

PERFECT TEMP
HEATING • COOLING • GEOTHERMAL

It’s Not This…

What It Is

- Heat pump technology
- Electrically powered
- Uses a closed or open ground loop as source
- Provides heating, cooling and hot water

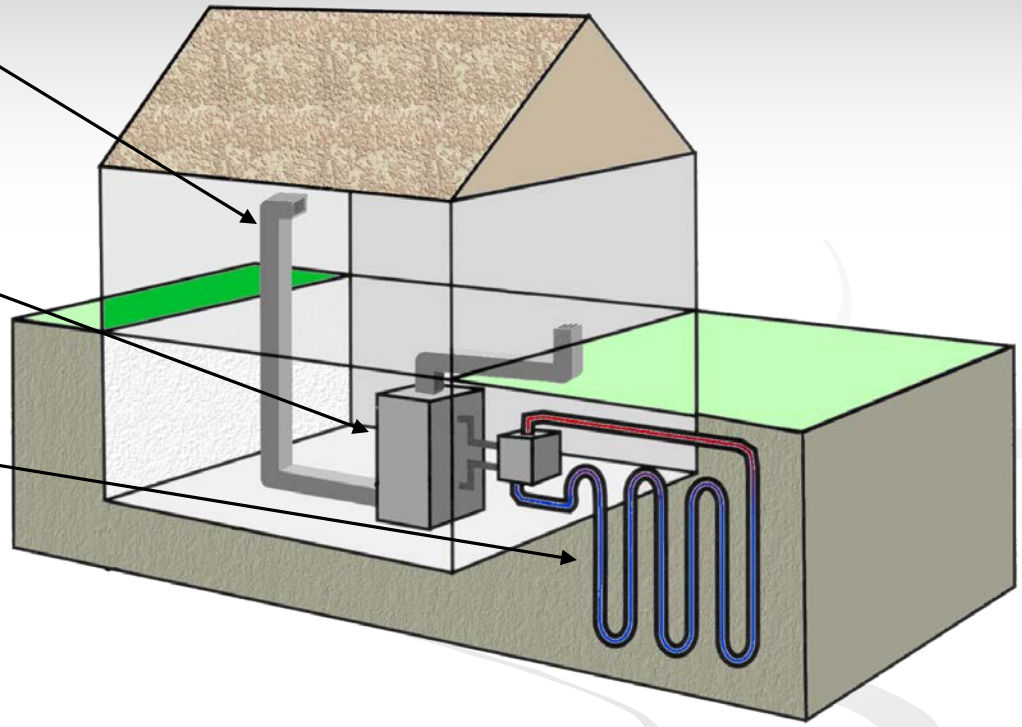
How It Works

- All day long, 365 days a year the earth stores the energy it receives from the sun.
- 48% of our sun's energy that reaches our planet is absorbed into the ground.
- In Colorado, the earth's temperature 6 feet underground, remains 55º-65º year 'round.

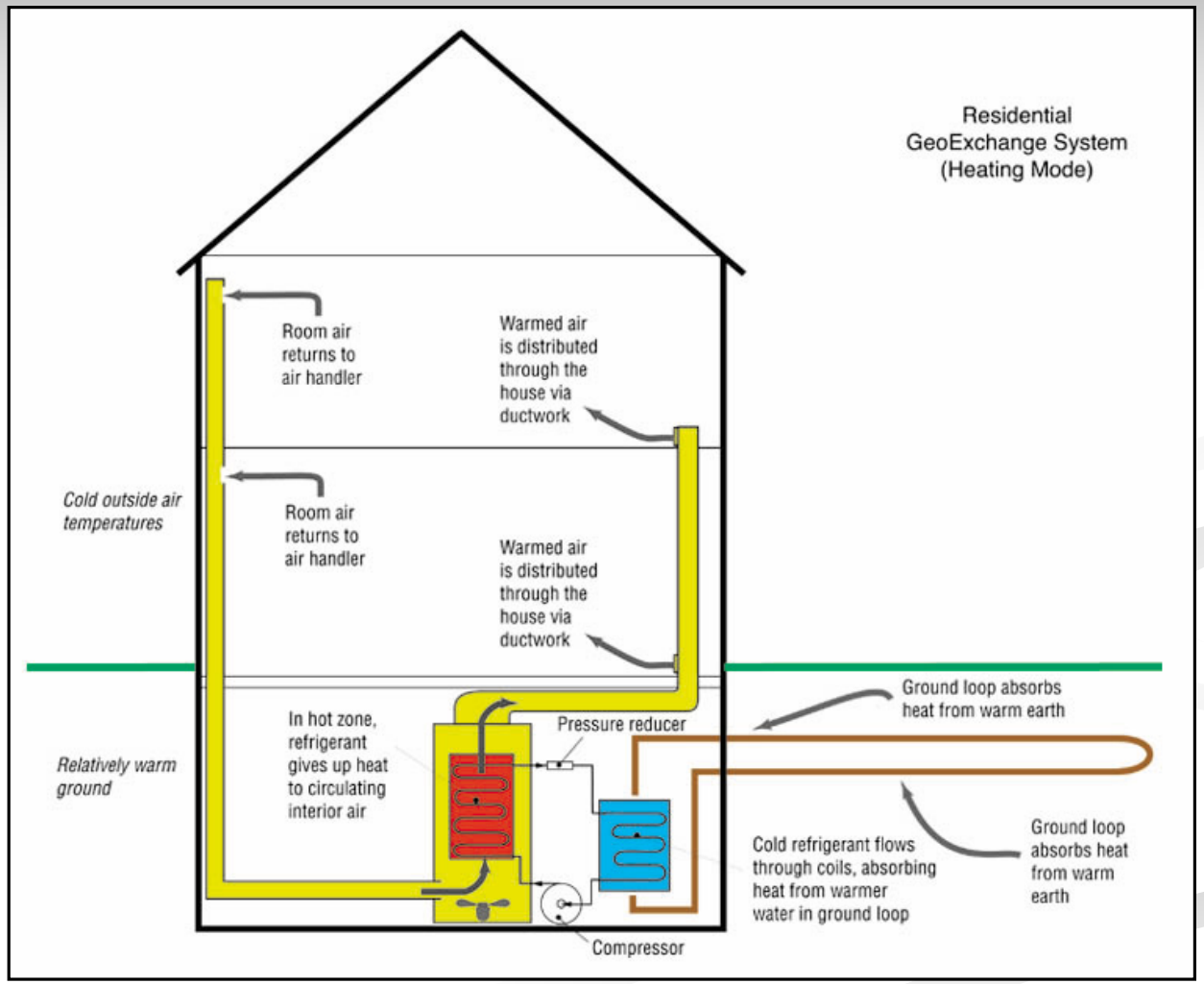
PERFECT TEMP
HEATING • COOLING • GEOTHERMAL

Three Sub-Systems

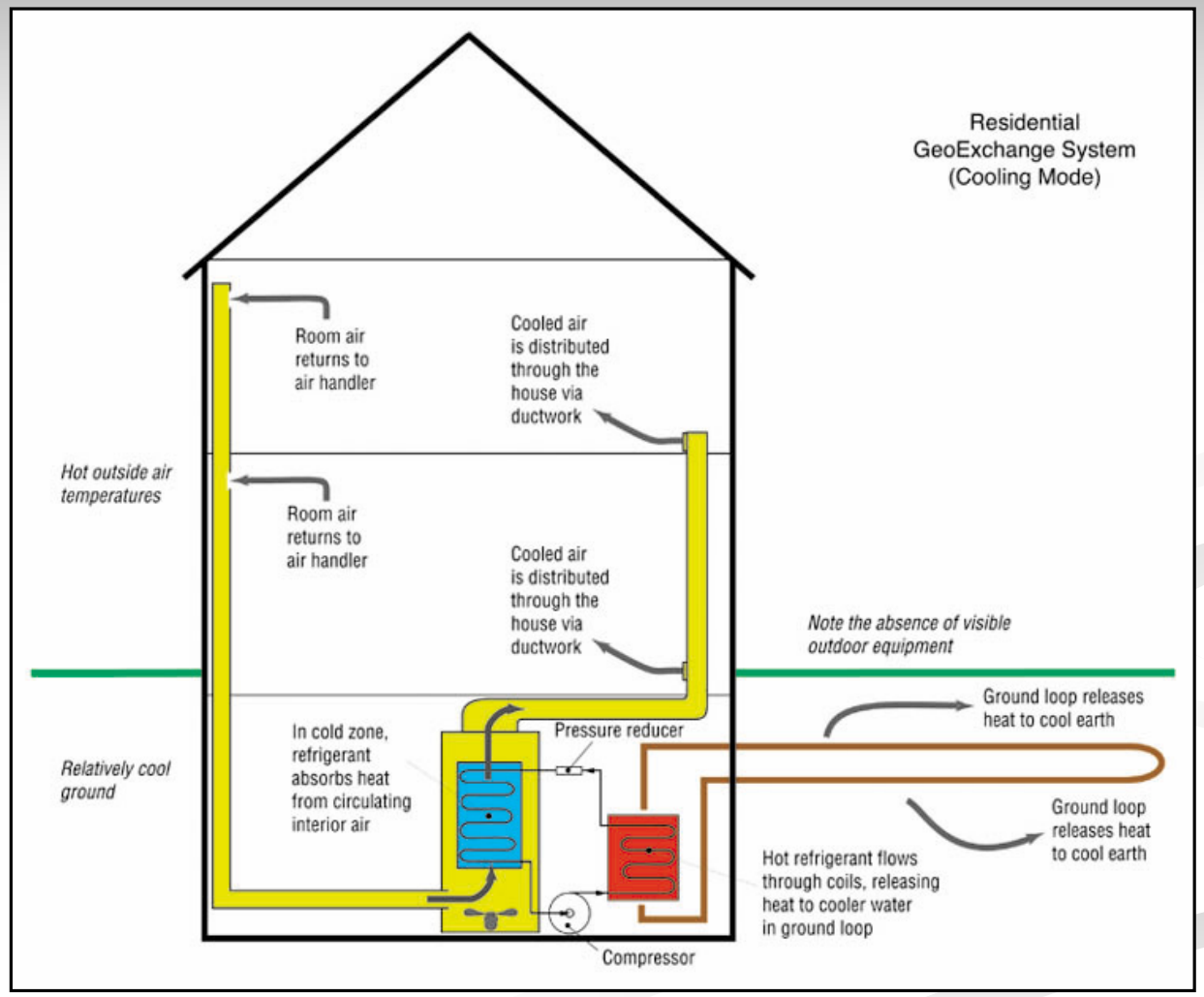
- The Ductwork (or Radiant Floor)
  - Air Return
  - Air Supply
- The Geothermal Unit
  - Compressor
  - Pumps
- The Ground Loop
  - Filled with a heat transfer fluid
- Because of their rugged construction and by not being located outdoors, geothermal systems can reduce maintenance costs by 40-60%.



Heating Mode Operation



Cooling Mode Operation



How It Works

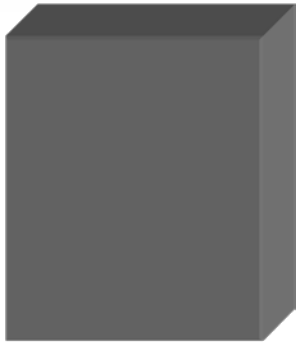
- Refrigerants are the key.
  - Refrigerants have the ability to get extremely cold (zero degrees F) while remaining flow-able.
  - Extremely cold things (0 F) can “harvest” heat from lukewarm things (55 F).
- Geothermal systems are “heat movers”.
  - They do not create heat. They move it from the ground to your building.

Confused?

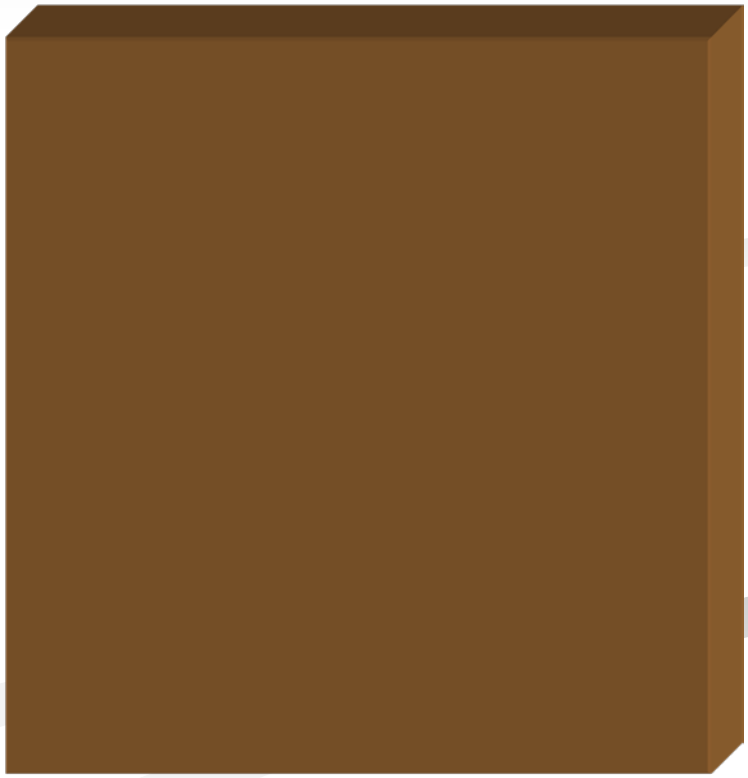
- Huh? If the ground is only 55 degrees, how does it heat my building to 75 degrees?
  - It's basic refrigeration.
  - Think not in terms of temperature.
  - Think in terms of *heat content*.
- How does your air conditioner work?
  - If it's 90 degrees outside, how does it cool your house to 70 degrees?

A Furnace vs. Your Backyard

- Small block of stuff.
- 50 lbs.
- 120 degrees F.



- Huge block of stuff.
- 5,000,000 lbs.
- 55 degrees F.



Which One Has More Heat?

PERFECT TEMP
HEATING • COOLING • GEOTHERMAL

Still Confused?

- In fact, a Geothermal unit *concentrates* the heat energy from the ground.
  - This brings the temperature up to a more useable level.
- Advanced fact:
  - What really happens is the heat from the ground causes the refrigerant to *evaporate*.
  - Changing a substance from liquid to vapor results in a large transfer of energy; called the latent heat of vaporization.
  - This energy moves from the ground to the refrigerant.

The Geothermal Unit

- There are four types of Geothermal units.
  - Water to air. (Geo to Forced Air)
    - Produce warm and cool air (50 -110 deg F).
  - Water to water. (Geo to In-floor Radiant)
  - Produce hot and chilled water (40 -110 deg F).
  - Split. (Geo to Forced Air with a Separate Blower)
    - Produce hot and cold refrigerant.
  - Combination. (Radiant Floor Heating and Forced Air Cooling)
    - Produce warm and cool air (50-110 deg F) and hot water (110 deg F).

The Geothermal Unit

- Combination

- Water to Water

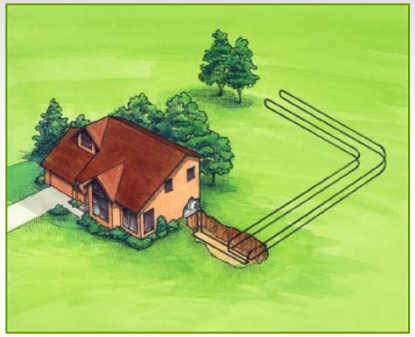
- Split

- Water To Air

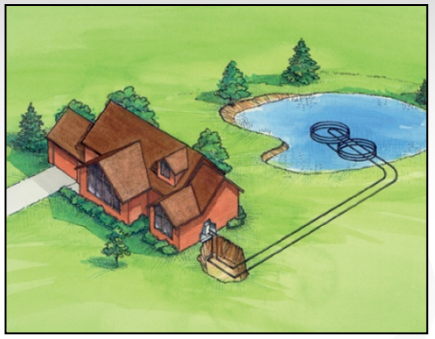
PERFECT TEMP
HEATING • COOLING • GEOTHERMAL

The Geothermal Ground Loop

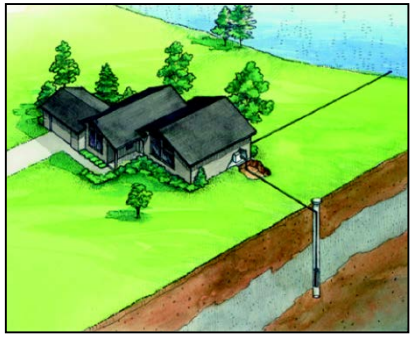
- Horizontal Loop



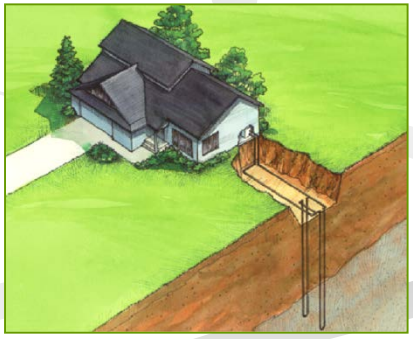
- Pond Loop



- Open Loop



- Vertical Loop



The Geothermal Ground Loop

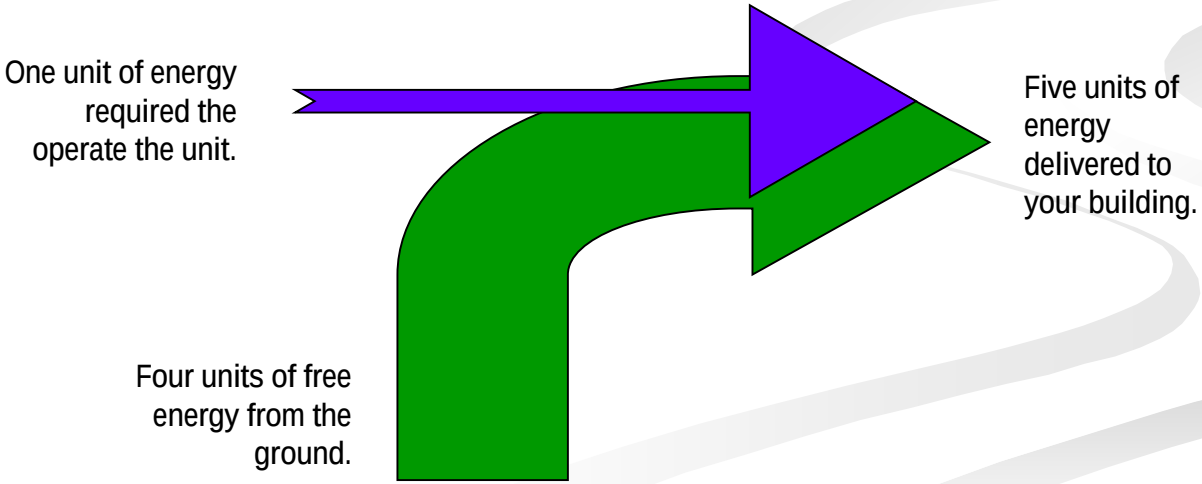
- Uses tough polyethylene pipe.
  - 100 year half-life in the ground.
  - Similar to underground natural gas pipe.
  - Joints are heat fused. No mechanical joints.
  - Filled with environmentally friendly water-based fluid.

Benefits

- Save money.
  - Cut energy cost's by 60% or more compared with conventional systems.
  - Cut maintenance cost's by 30% or more compared with conventional systems.
  - Save thousands of dollars over the life of the system.
  - Geothermal systems have the lowest life cycle cost of any type of HVAC system.

Benefits

- The most efficient heating, cooling and hot water system available.
  - Heating efficiency: Up to 500%.
  - Cooling efficiency: Up to 45 SEER.



More Than 100% Efficient?

- Coefficient Of Performance (COP)
  - All heat pumps are rated in COP.
  - $= \dfrac{\text{what you get}}{\text{what it costs to get it}}$
  - $= \dfrac{\text{five units of energy delivered}}{\text{one unit of energy to operate the unit}}$
  - $= 5$
  - (this is equivalent to 500%)

Benefits

- Lowest cost per BTU
  - One therm = 100,000 btu's.
    - Propane cost per therm = $2.42
      (based on 90% efficient appliance, $2.00/gal)
    - Natural gas cost per therm = $1.67
      (based on 90% efficient appliance, $1.50/therm)
    - Air conditioner cost per therm = $0.76
      (based on 13 SEER unit, $.08/KW)
    - Geothermal cost per heating therm = $0.67
      (based on 3.5 COP, $.08/KW)
    - Geothermal cost per cooling therm = $0.40
      (based on 20 EER unit, $.08/KW)

Benefits

- Rate stability since 1973
  - Fossil fuels (natural gas and propane): +1,000%
  - Electricity: +200%

Benefits

- Enjoy better comfort.
  - Geothermal systems provide a more even temperature throughout the home compared to conventional systems.
  - No thermostat temperature swing.
  - Heating supply temperatures of 90-110 degrees F.
  - Cooling supply temperatures of 48-57 degrees F.
  - Two speed units run on low speed most of the time. The owner will not be aware that the system is even running.

Benefits

- Aesthetics and flexibility.
  - No outdoor condensing units.
  - Units available in a variety of configurations.
  - No venting.
  - No combustion air requirements.

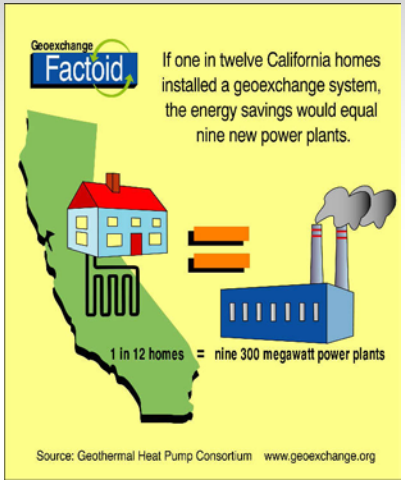
Benefits

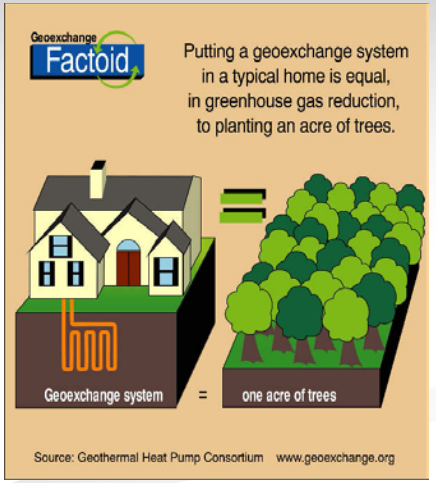
- Safety.
  - No possibility of CO poisoning.
  - No possibility of explosions.
  - No flames.

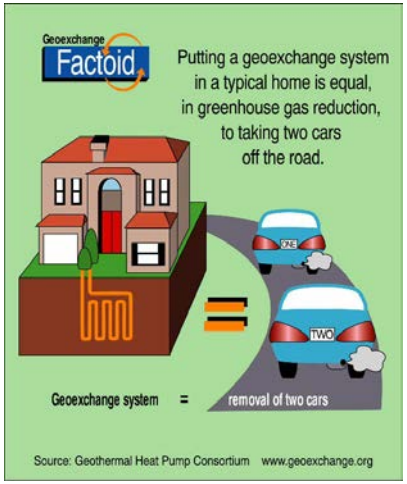
Benefits

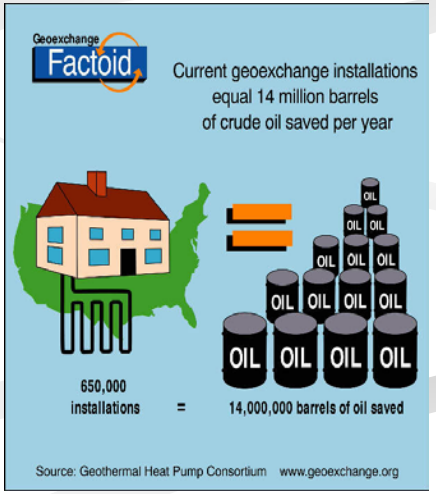
- Better for the environment.
  - Geothermal systems use solar energy; an infinitely renewable source of energy.
  - Geothermal systems produce and reject 4-5 times more energy than they consume.
  - Geothermal systems do not directly emit greenhouse gases.

Benefits









PERFECT TEMP
HEATING • COOLING • GEOTHERMAL

Geothermal and Net Zero Buildings

- Net Zero Buildings generate 100% of their own energy needs onsite.
- Two-thirds of the average home's energy bill comes from heating, cooling and hot water.
- Geothermal systems reduce energy usage by so much that the building can operate using electricity generated from solar or wind system.

Geothermal and Net Zero Buildings

- The Revive Community in Fort Collins, Colorado's first Department of Energy Zero-Energy Development.
  - 100% Geothermal generated heating, cooling and hot water.
  - Solar PV
  - Energy Star Certified Construction

Tax Credits and Rebates

- Federal Tax Credit – Individuals
  - 30% of total system cost (through 2019)
  - 26% of total cost (2020); 22% of total cost (2021)
  - Expires after 2021
- Federal Tax Credit – Commercial
  - 10% through 2021
- Fort Collins/Efficiency Works - $500
- PVREA - $500/ ton; maximum $3,500
- Excel - $300/ ton; max $1,500

In Summary

- Geothermal heat pump systems are:
  - Renewable
  - Clean
  - Combustion-free
  - Safe
  - Aesthetically-pleasing
  - Proven
  - Affordable
  - New construction or renovations
  - Nearly any size lot

PERFECT TEMP
HEATING • COOLING • GEOTHERMAL

Q & A

Chris Butts
Perfect Temp Geothermal
(970) 663-4993
chris@perfecttemphvac.com
www.perfecttemphvac.com

Copies of this presentation are available upon request.