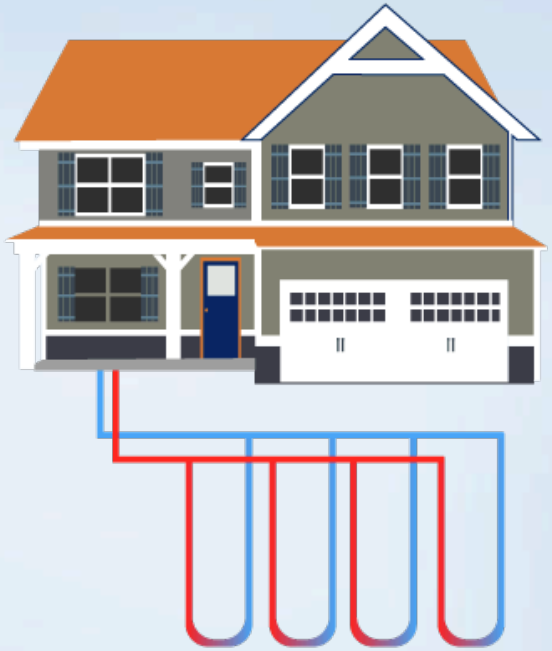
Welcome to the

Geothermal
Urbana-Champaign

Power Hour!



We will begin shortly with instructions on how to interact with our presentation

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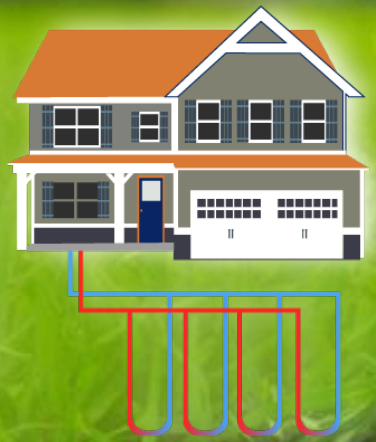

A group buy opportunity for geothermal heat pumps: the most efficient and environmentally beneficial heating and cooling systems available today

Today's Agenda

- What is the Geothermal Urbana-Champaign group buy program?
- What is Geothermal power?
- Cost and savings incentives
- How to begin your geothermal journey!

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What is a Geothermal Group Buy?

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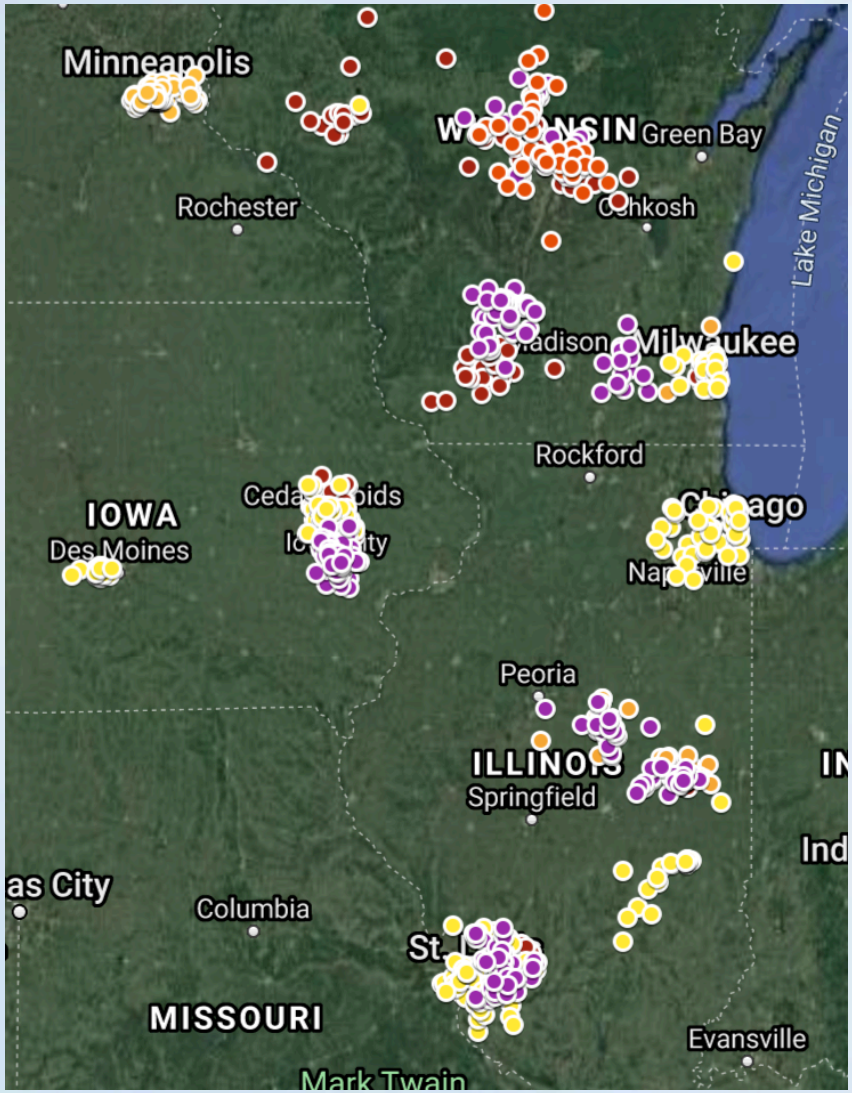

What is a Group Buy?

NREL Model for Lower Prices:

1. Economy of Scale
2. Community-Led Outreach
3. Strong Customer Education
4. Limited-time Offering
5. Competitive Contractor Selection

Everyone wins!

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Geothermal Urbana-Champaign Group Buy

- 15 Geothermal Power Hour webinars. **Deadline May 30, 2021 .**
- Open to **Champaign, Piatt, and Vermillion County** residents, businesses, farms & nonprofits
- **All-in Pricing**. Program pricing includes turnkey design, permitting, components, installation
- **Additional rebates** as more systems are contracted in the program territory
- Residential financing & U.S.-made products available.

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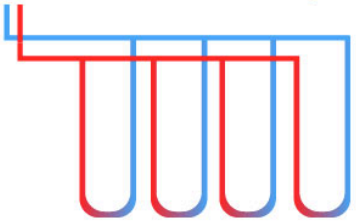

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Design-Air
HEATING & AIR CONDITIONING

About Design-Air:

- Family owned since 1977
- More than 1700 geothermal systems installed since 1985
- 27 Full time employees
- GAOI/NATE certified technicians WaterFurnace Geo Pro Master Dealer
- BBB A+

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How Geothermal Energy Works

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Geothermal Energy Systems are Called Many Things

- Ground-source heat pump
- Geo-exchange
- Geothermal heat pump
- Earth-coupled heat pump
- Geo
- Earth Energy

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Geothermal Heat Pumps Produce On-Site RENEWABLE Energy

- Geothermal systems use the ground as a moderate-temperature heat source during the winter and a heat sink during the summer
- Geothermal systems draw RENEWABLE thermal energy from the ground during the winter to heat buildings and reject excess heat from buildings back into the ground in the summer

So in the summer, Geothermal systems RENEW the Heat that they tapped from the ground during the previous winter season

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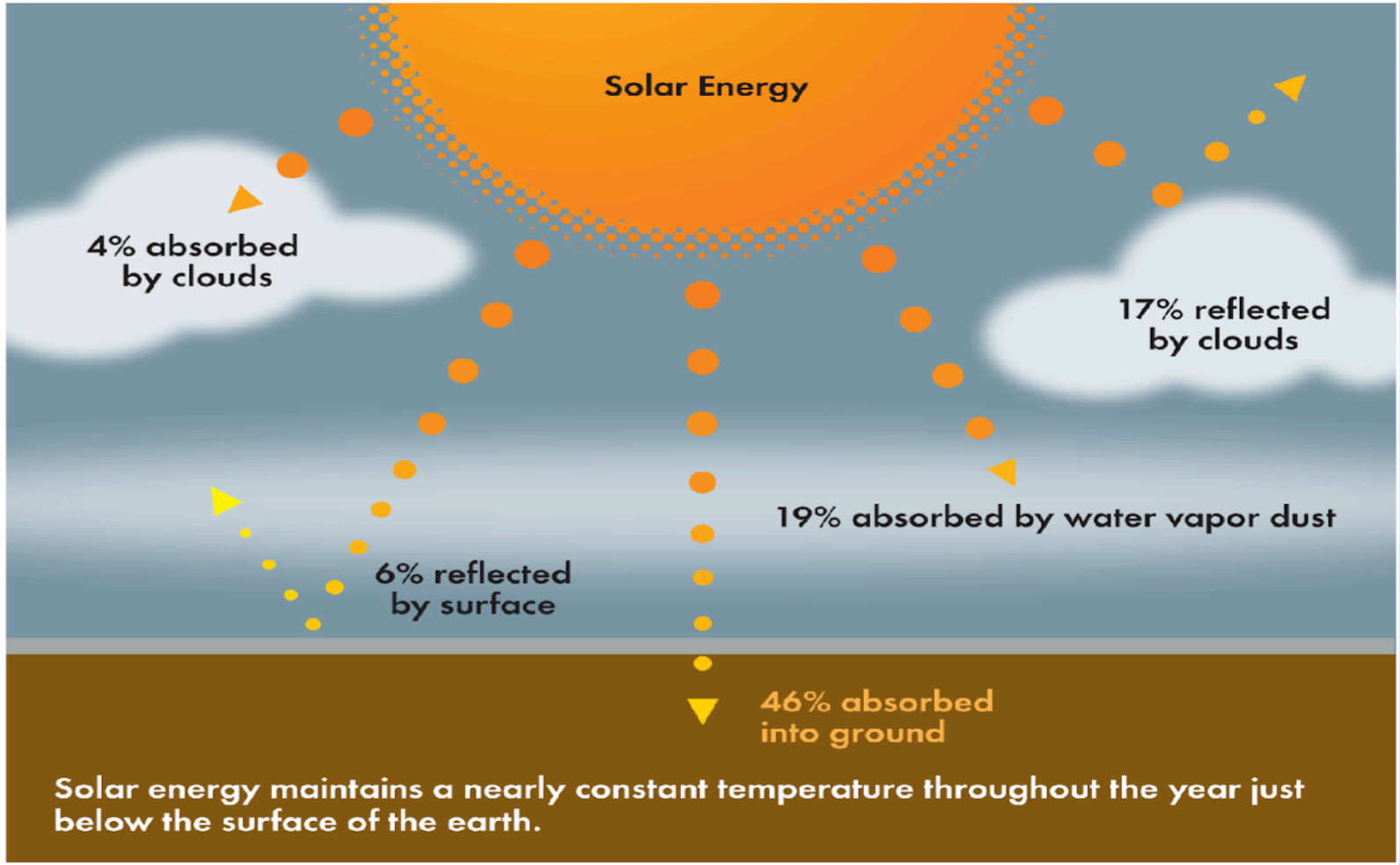
Earth is a Vast Solar Collector



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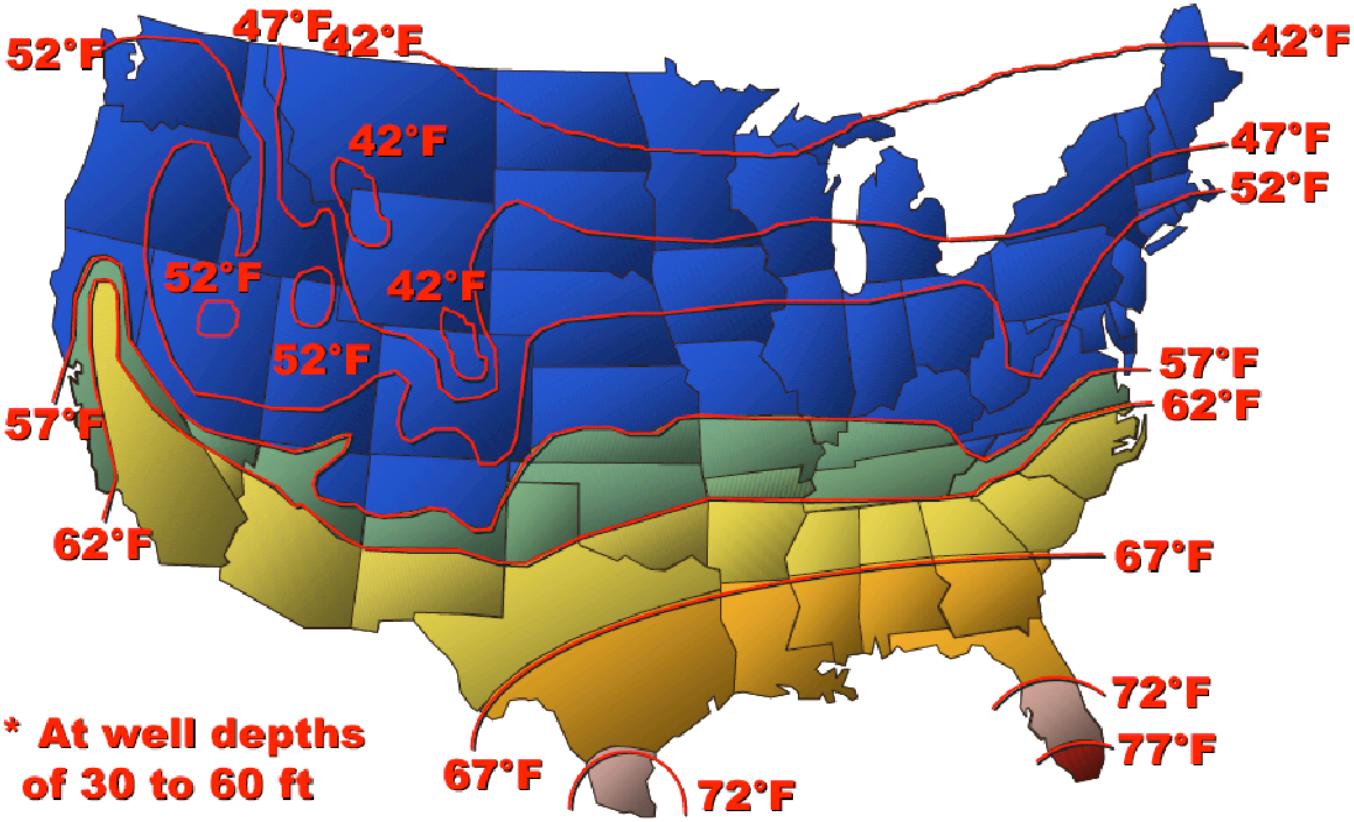
U.S. Underground Temperatures



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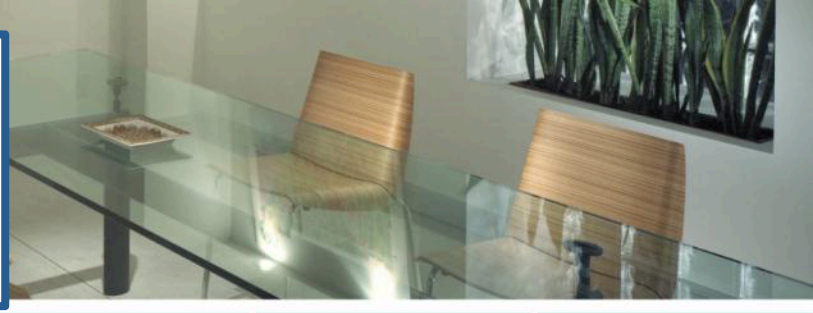
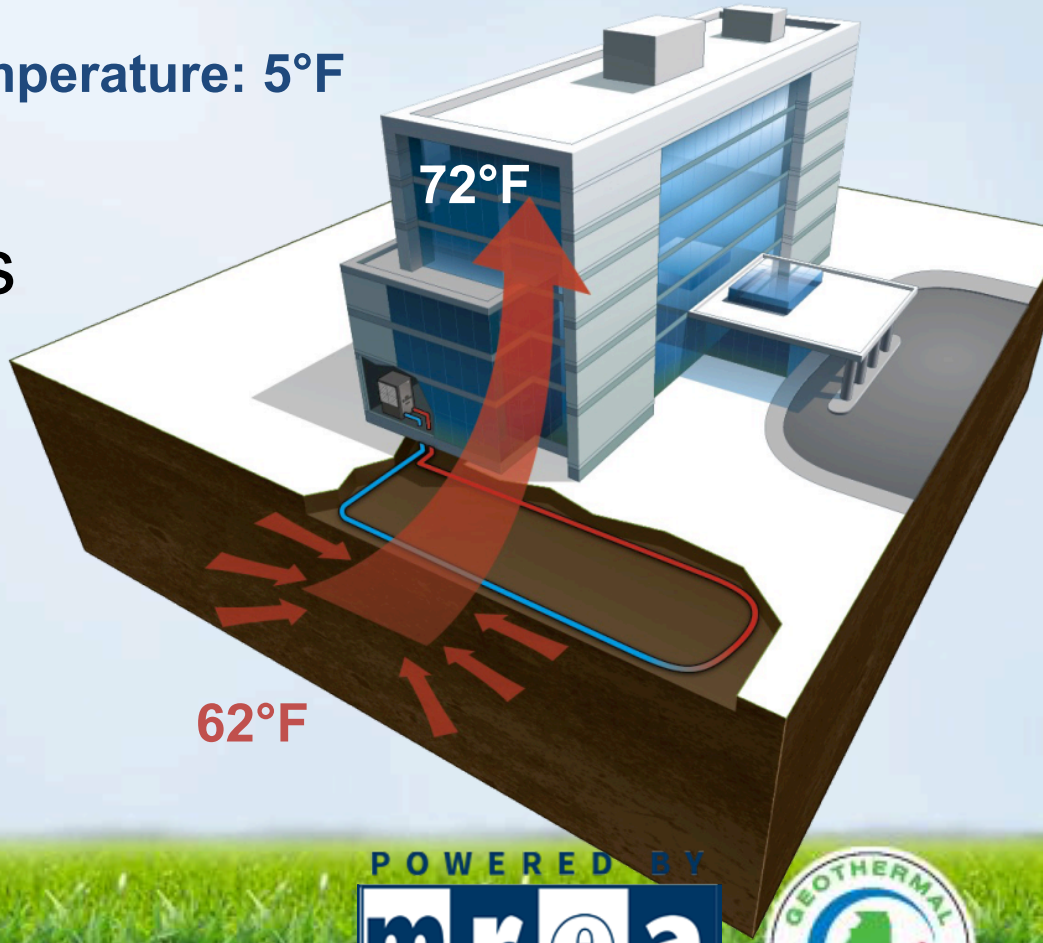
The Earth is a Source of Heat in Winter…



Outdoor air temperature: 5°F

Geothermal heat pumps transfer moderate heat into the building to provide heating



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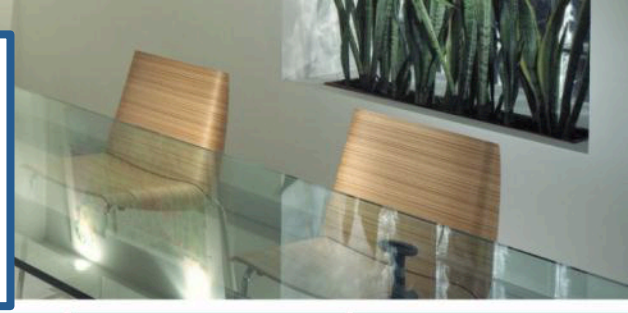
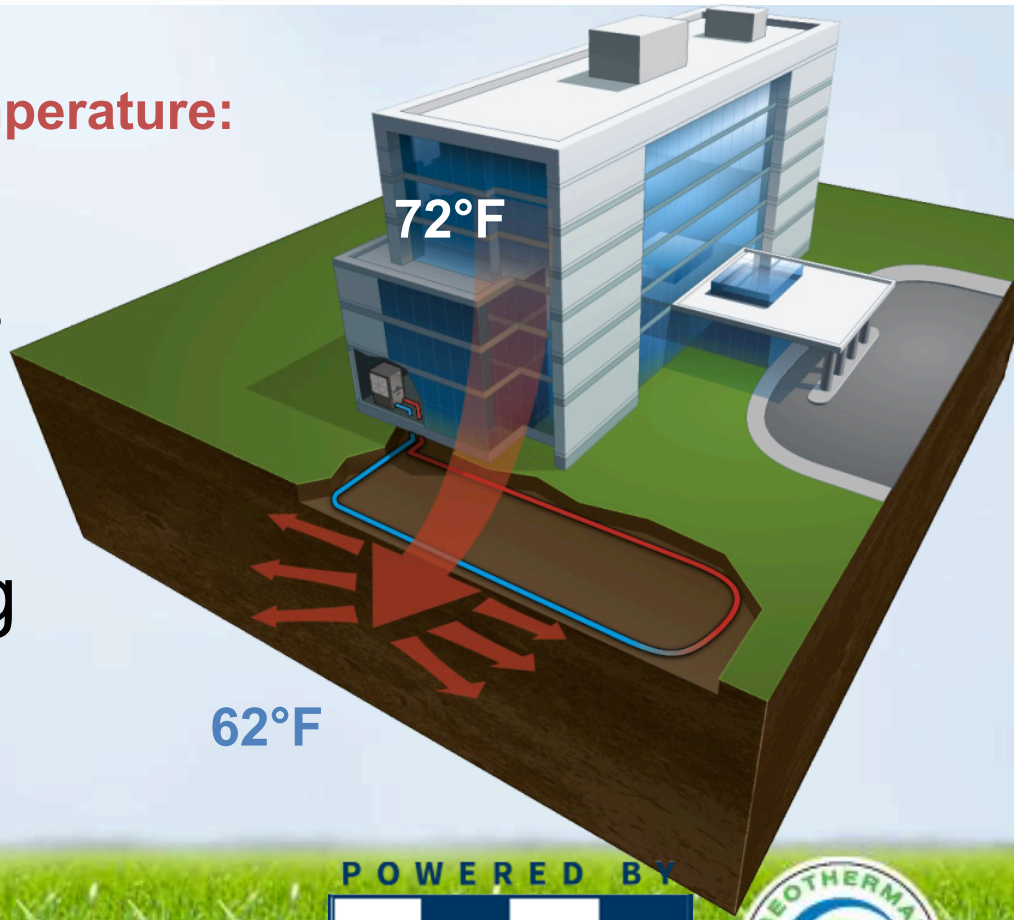
...And an Efficient Place to Reject Heat in Summer…



Outdoor air temperature:
100°F

Geothermal heat pumps transfer excess heat from the building to the ground providing cooling



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Using Geothermal Technology

Geothermal heat pumps (GHP) circulate water through a sealed underground piping loop where it is naturally warmed (or cooled) by the earth

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GHPs Transfer Heat Efficiently

1 kWh of energy purchased from the grid to operate a GHP system

Yields 4-6 kWh of energy for the building

3 to 5 kWh of RENEWABLE energy absorbed from the earth

IS FREE

400-600% Efficiency

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Geothermal is not a New

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Geothermal is not a New Technology

FIRELESS FURNACE

It pumps heat from earth to house

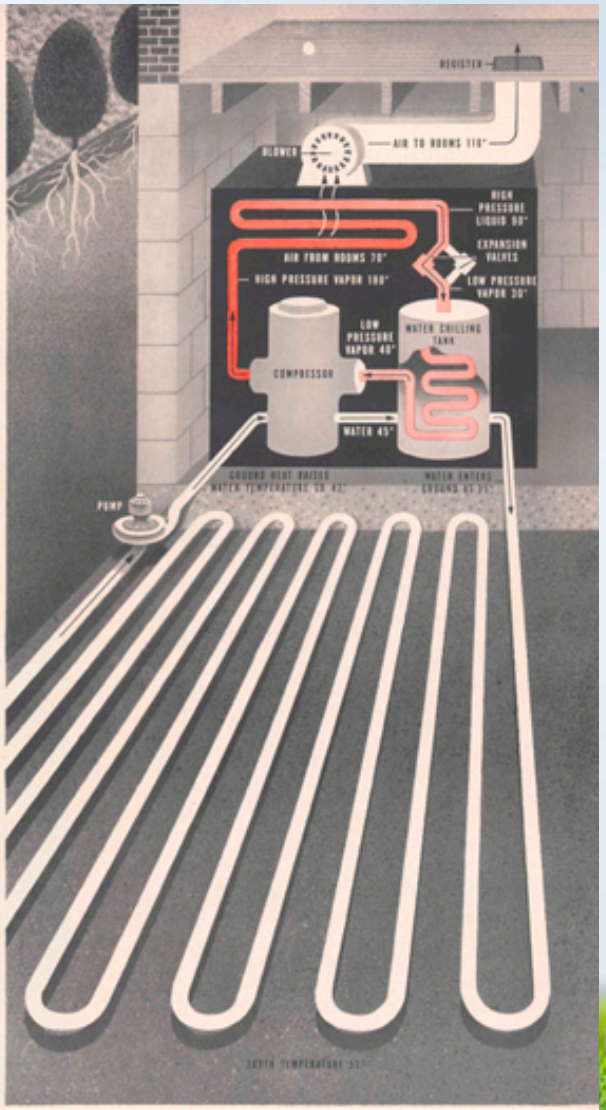
The machine shown at the bottom of the page and explained in the diagram at right burns no fuel, yet it can heat a house in winter, cool it in summer and is at the same time a humidifier. It produces no ashes, soot or smoke and needs no chimney. It is called a heat pump.

Powered by an electric motor, it works on the same principle as a home refrigerator. Just as a refrigerator takes heat from the food and air inside it and deposits it in the kitchen, the heat pump, when cooling a house, takes heat from the house and deposits it in the earth through pipes buried in the soil. To warm a house the heat pump uses the low temperature heat constantly contained in the earth, increases its temperature and puts it in the house. This is done as follows: water circulating through pipes in ground enters a tank in which are pipes carrying a cold refrigerant, Freon. The Freon, being colder than the water, picks up some of its heat, then goes through a compressor. This compression makes the Freon hot. This heat is used to heat house. Freon is then allowed to expand suddenly and as a result again becomes cold. Next it passes back through the water tank, once more picking up additional heat from the ground-warmed water.

It will be some time before most home owners can buy a heat pump right off a dealer's floor. Today each heat pump installation is a separate and expensive engineering problem. The one shown here, called the Miracula, made by the General Engineering and Manufacturing Company of St. Louis, Mo., sells for $2,000. Installation adds another $1,000.

At present the heat pump costs slightly more to operate than an ordinary furnace except in areas of especially low electric rates. In many places, too, installation is totally impractical. However as the efficiency of getting heat from the earth improves, it is almost certain that eventually the heat pump will be able to compete successfully with conventional heaters in most localities. Many large companies have heat pumps under development. Even conservative General Motors admits informally that it is working on a Frigidaire version of the heat pump for the consumer market.

EXPOSED VIEW OF HEAT PUMP shows parts diagramed at right. Compressor is at bottom left, chilling tank at bottom right and blower at top center. Unit is 6 feet 3 inches tall, occupies 6.3 square feet of floor space.



HOW HEAT PUMP WORKS in winter is shown by this diagram. Water circulates through ground pipes, picks up ground heat plus heat from compressor. This warmed water heats special Freon vapor in chilling tank (pink coils). Warmed Freon goes to compressor, becomes hot. Hot Freon goes through coils at top, warms house air. Freon returns to chilling tank through expansion valve. For summer cooling Freon flow is reversed.

CONTINUED ON NEXT PAGE

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Geothermal is not a New Technology

- Underground loop development using iron and copper loops in the 1940's. PB and PE pipe made viable in late 1970's
- Oklahoma State University began involvement in improving the technology in late 1970s driven by J. Bose, J. Partin, and G. Parker

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 or a refrigerator
- Geothermal Heat Pumps use the earth or well water to provide heating, cooling and hot water for your home
- A Geothermal heat pump “moves” energy to/from the ground, eliminating the outdoor equipment associated with ordinary heat pumps or air conditioners

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Geothermal Operation

- Geothermal heat pumps consist of four circuits:
  - **Distribution Circuit**
    - The system that distributes the conditioned air or water solution throughout the home or building and returns it to the unit
  - **Refrigerant Circuit**
    - A sealed and pressurized circuit of refrigerant including compressor, expansion valve, water-to-refrigerant heat exchanger(s), air coil, reversing valve. The refrigerant is either R-22 or R-410A

Geothermal Operation

- Geothermal heat pumps consist of four circuits:
  - **Ground Loop Circuit**
    - The piping system buried in the ground has fluid that is circulated by pumps to and from the geothermal unit
  - **Hot water circuit**
    - Domestic water can be heated in a geothermal unit with a device called a desuperheater. A piping connection is made from the geothermal unit to the water heater

Geothermal Operation

- Each of these circuits is closed and sealed from the others—there is no direct mixing to risk to the environment
- However, heat energy **does** transfer from the refrigeration circuit to the other three circuits
- The refrigerant flow will change direction when the unit changes modes (heating or cooling)

Heating water is the second largest use of energy in the home; ~20%

Domestic hot water is a free byproduct of a Geothermal system

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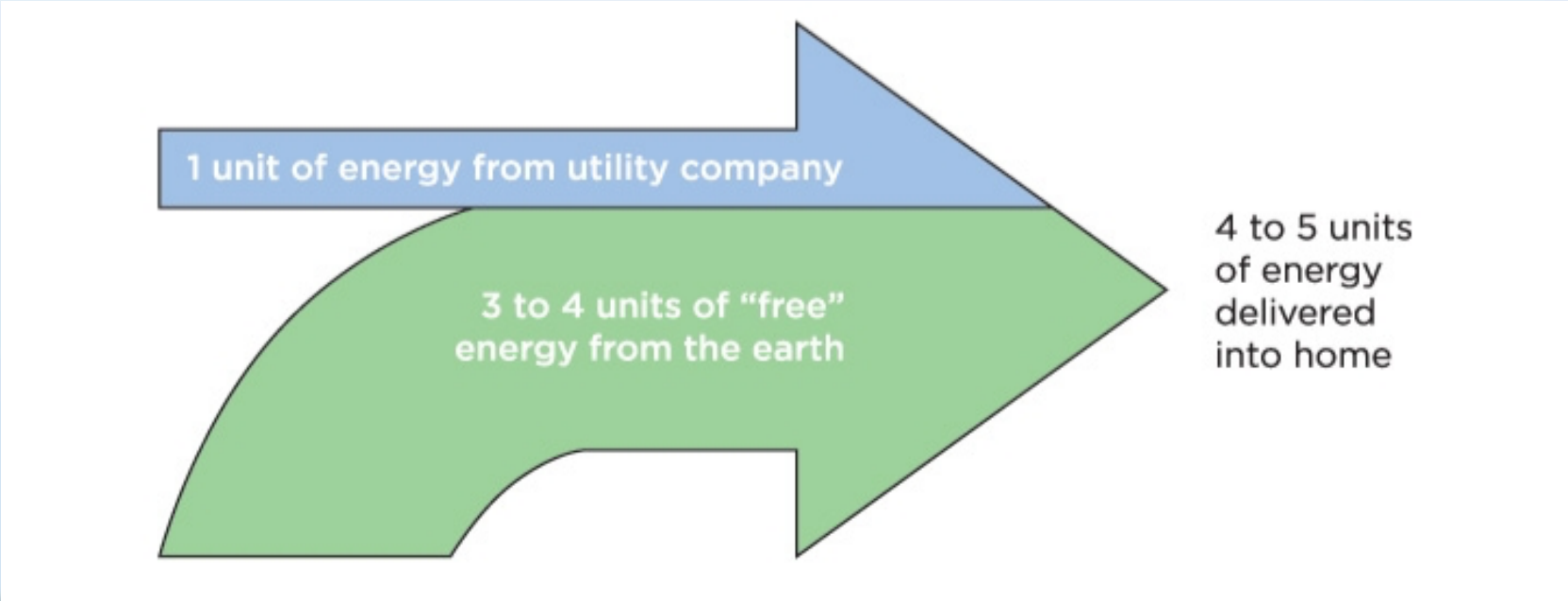
Free Energy

- Geothermal Heat Pumps use only a small amount of electricity to capture a large amount of FREE energy from the earth

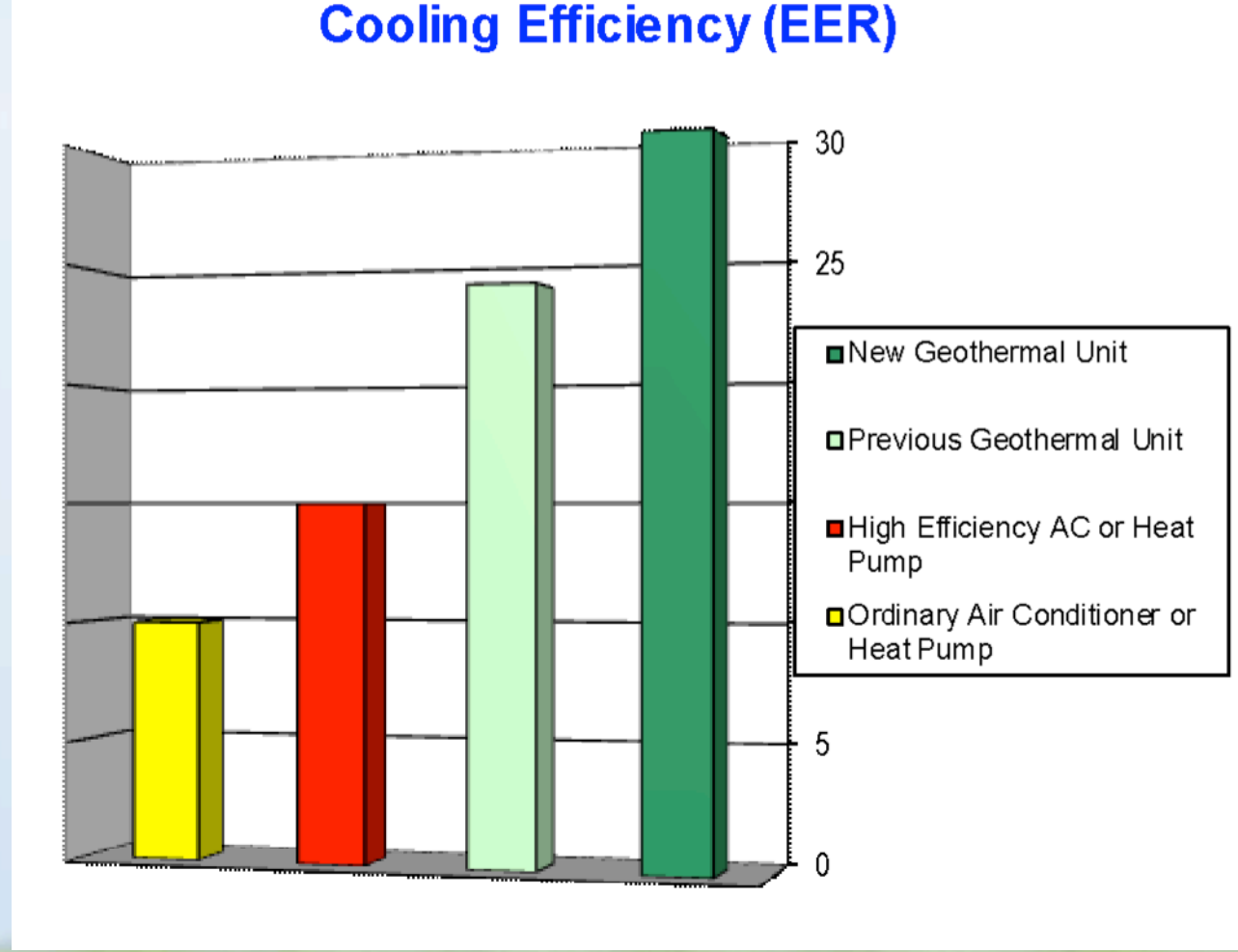


Equipment Performance Ratings

- ARI* has designated the efficiency ratings for water-to-air heat pumps as:
  - **Energy Efficiency Ratio (EER)**
    - EER = BTU output divided by power watt input
    - For cooling operation under steady state test conditions
  - **Coefficient of Performance (COP)**
    - COP = BTU output divided by BTU input
    - For heating operation under steady state test conditions

ARI* = Air-Conditioning and Refrigeration Institute

Geothermal Performance Comparison



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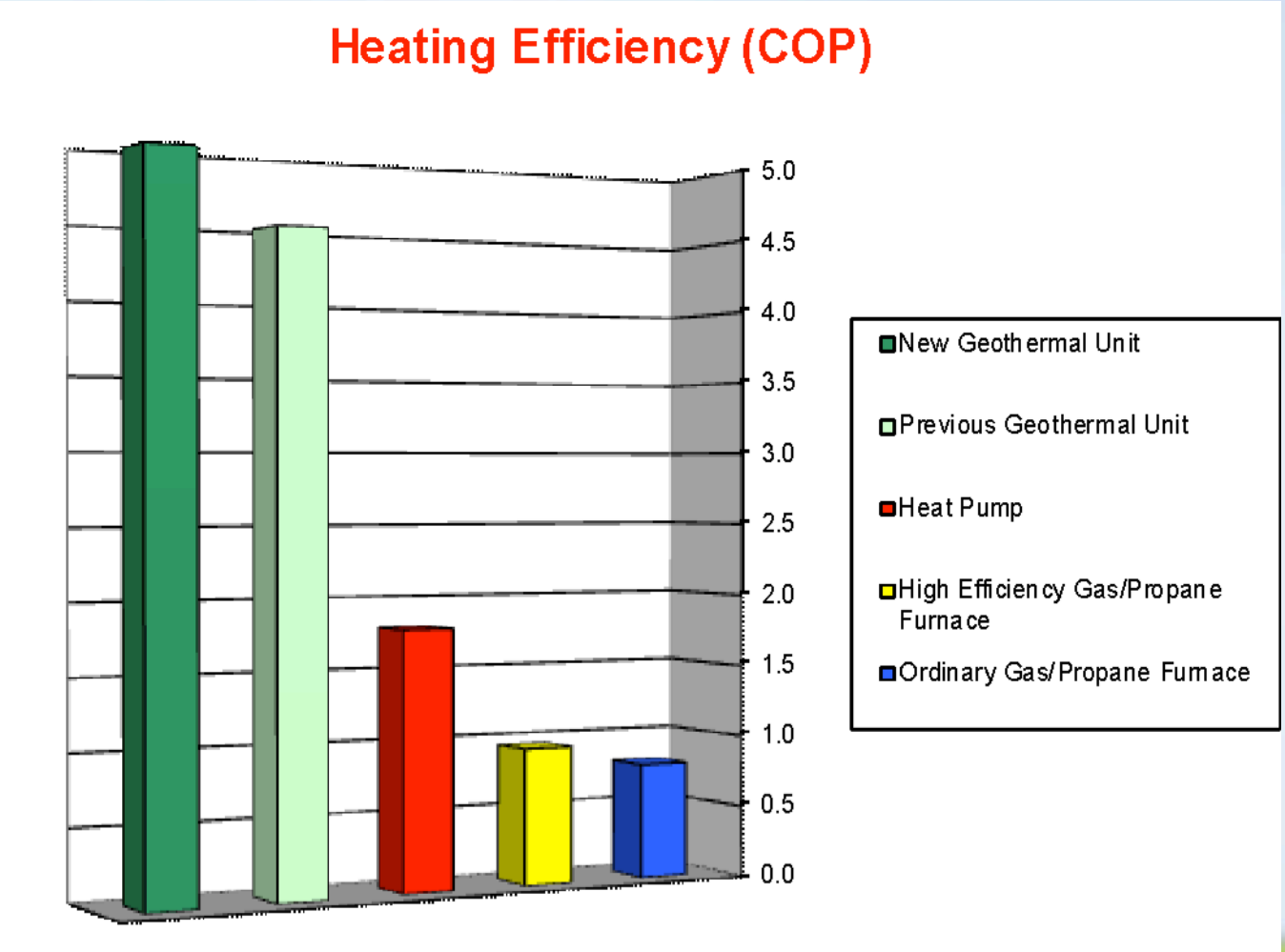
Geothermal Performance Comparison



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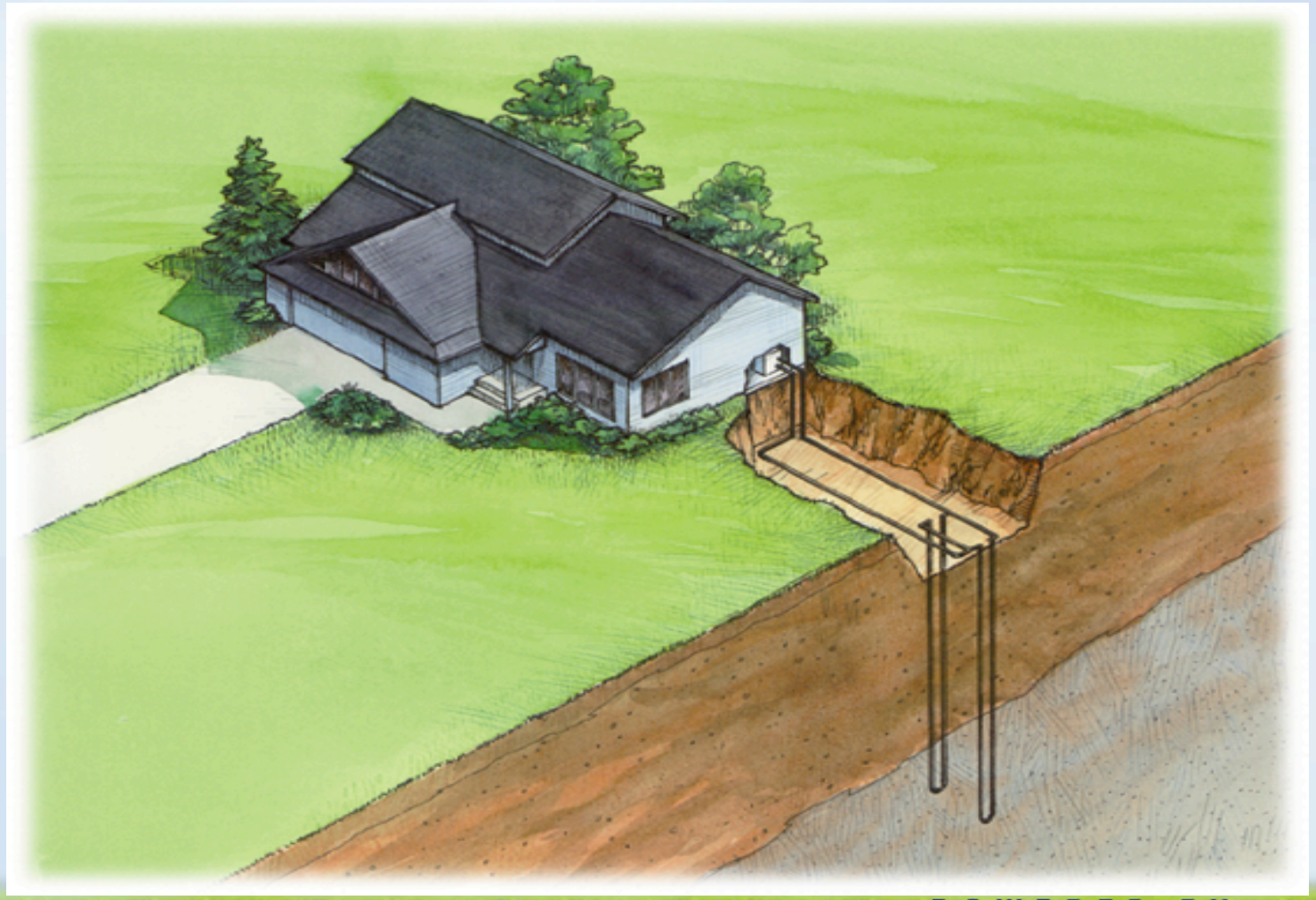
Loop Types

- Closed Loop (w/ antifreeze)
  - Horizontal
  - Vertical
  - Pond
- Open Loop (w/ groundwater)
  - Well Water

Vertical Loop



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Vertical Bore Without Backfill

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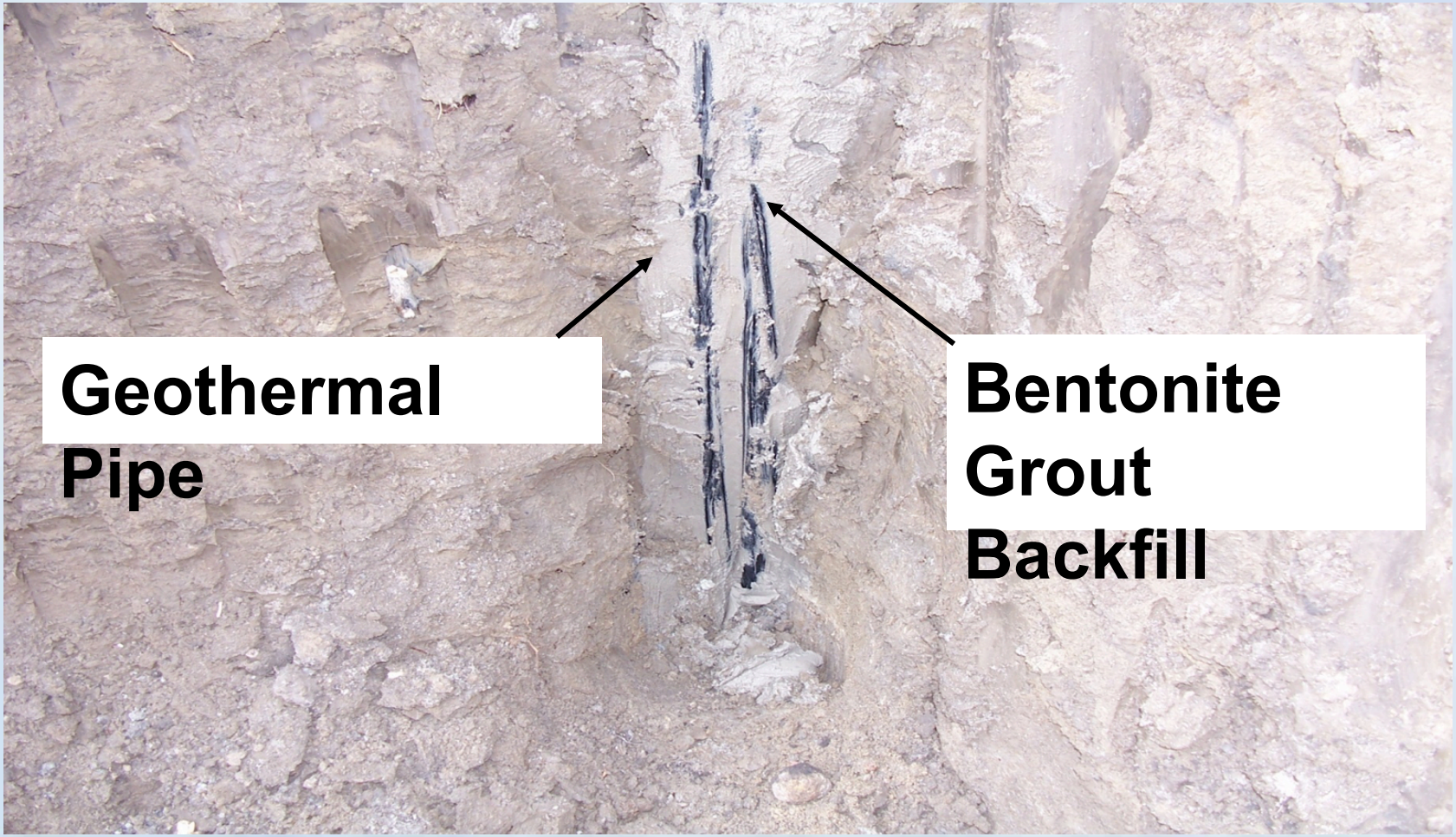
Vertical Loop/Grouted



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Retrofit Existing Home …
What Geothermal Loop Installation Will Look Like

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New Home Construction …

What Geothermal Loop Installation Will Look Like

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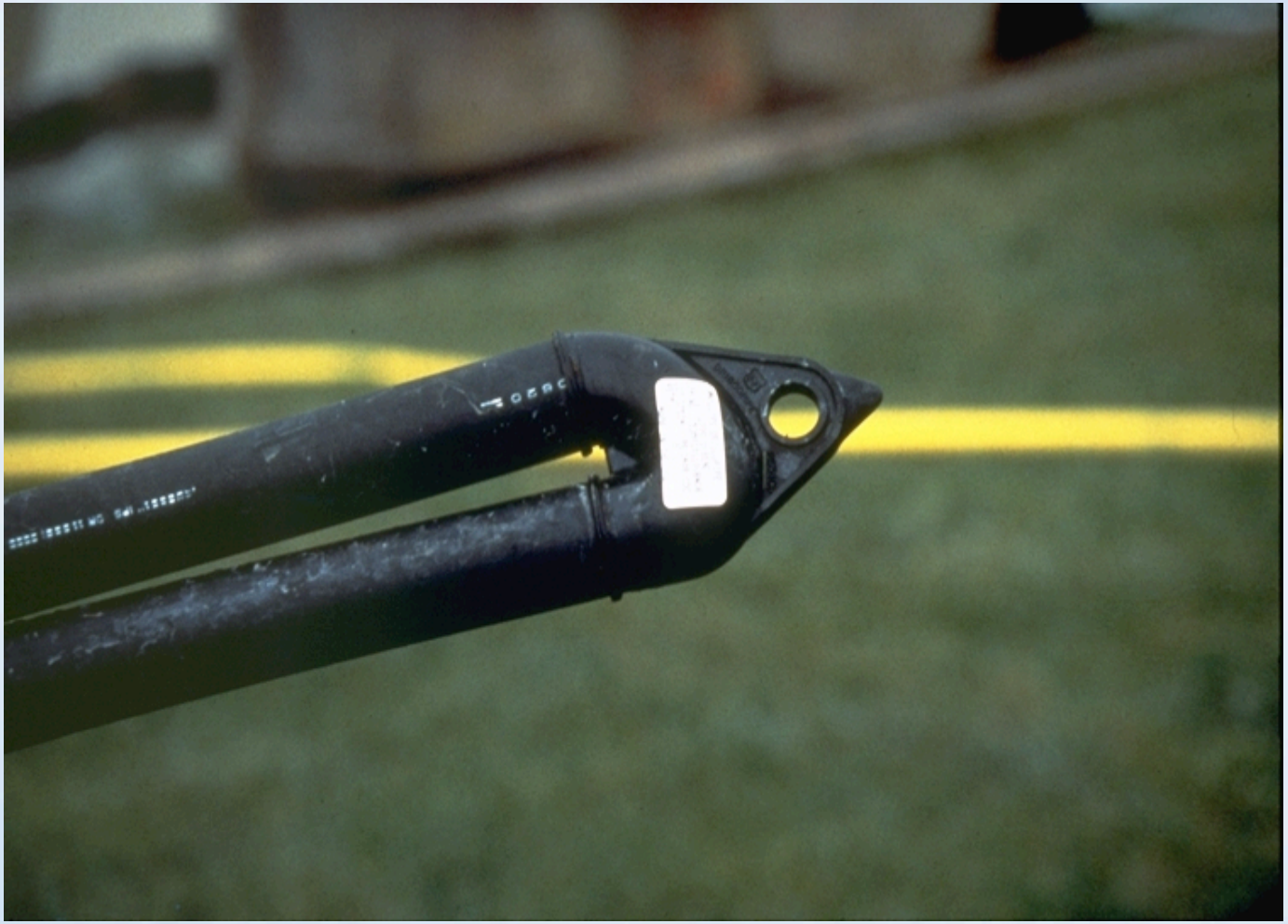
U-Bend Used for Vertical Loops



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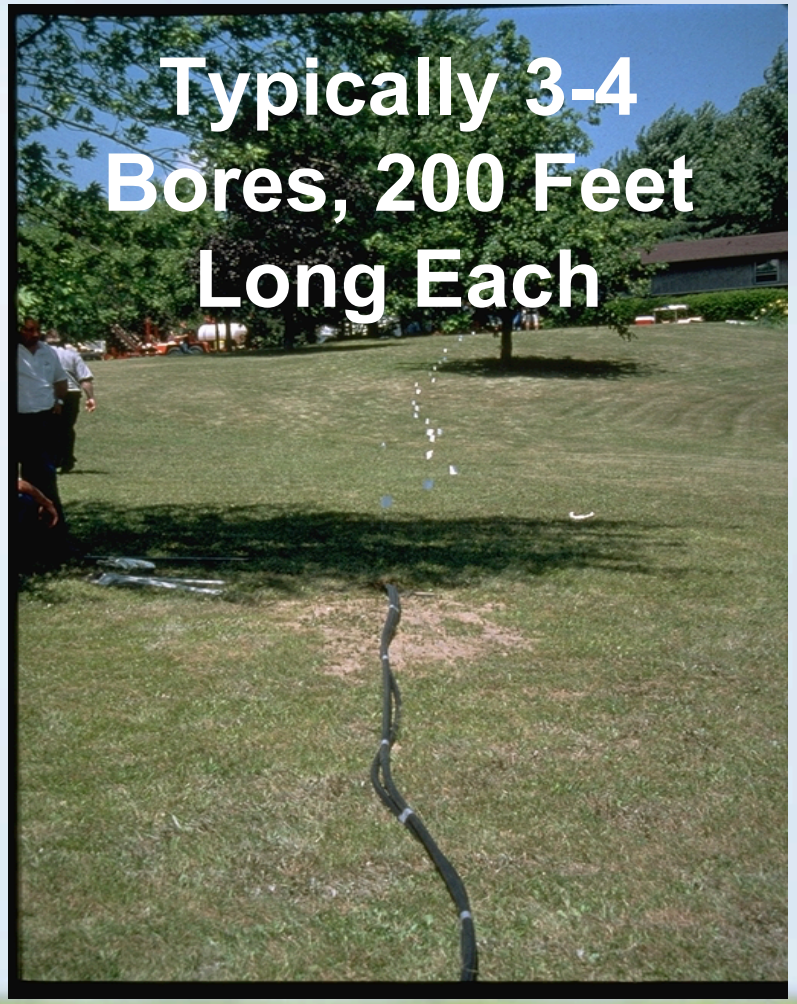
Horizontal Bore Loops



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Directionally Bored Loopfield…

What Geothermal Loop Installation Will Look Like

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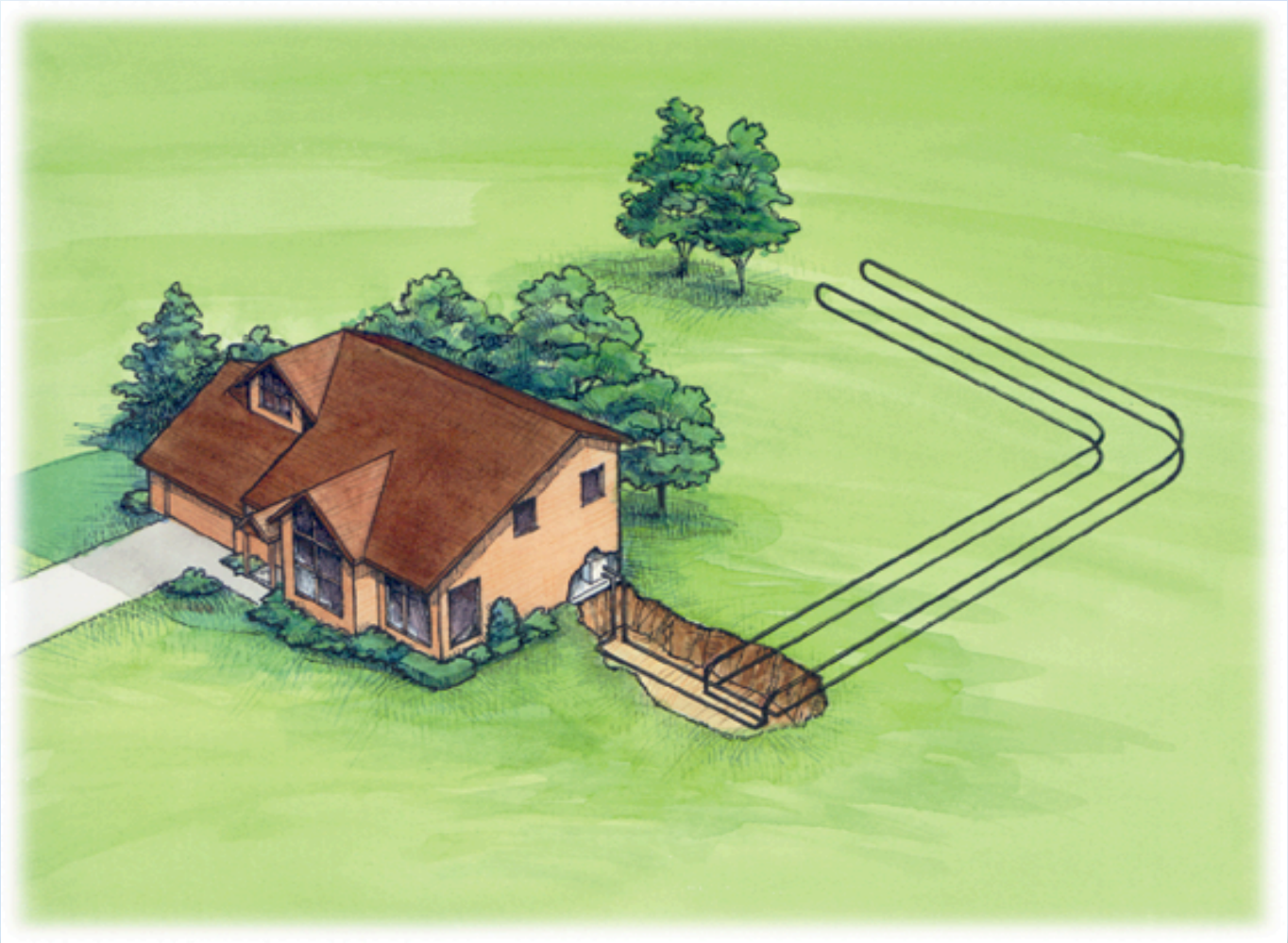
Horizontal Loop



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Horizontal 4 & 6 Pipe Loops

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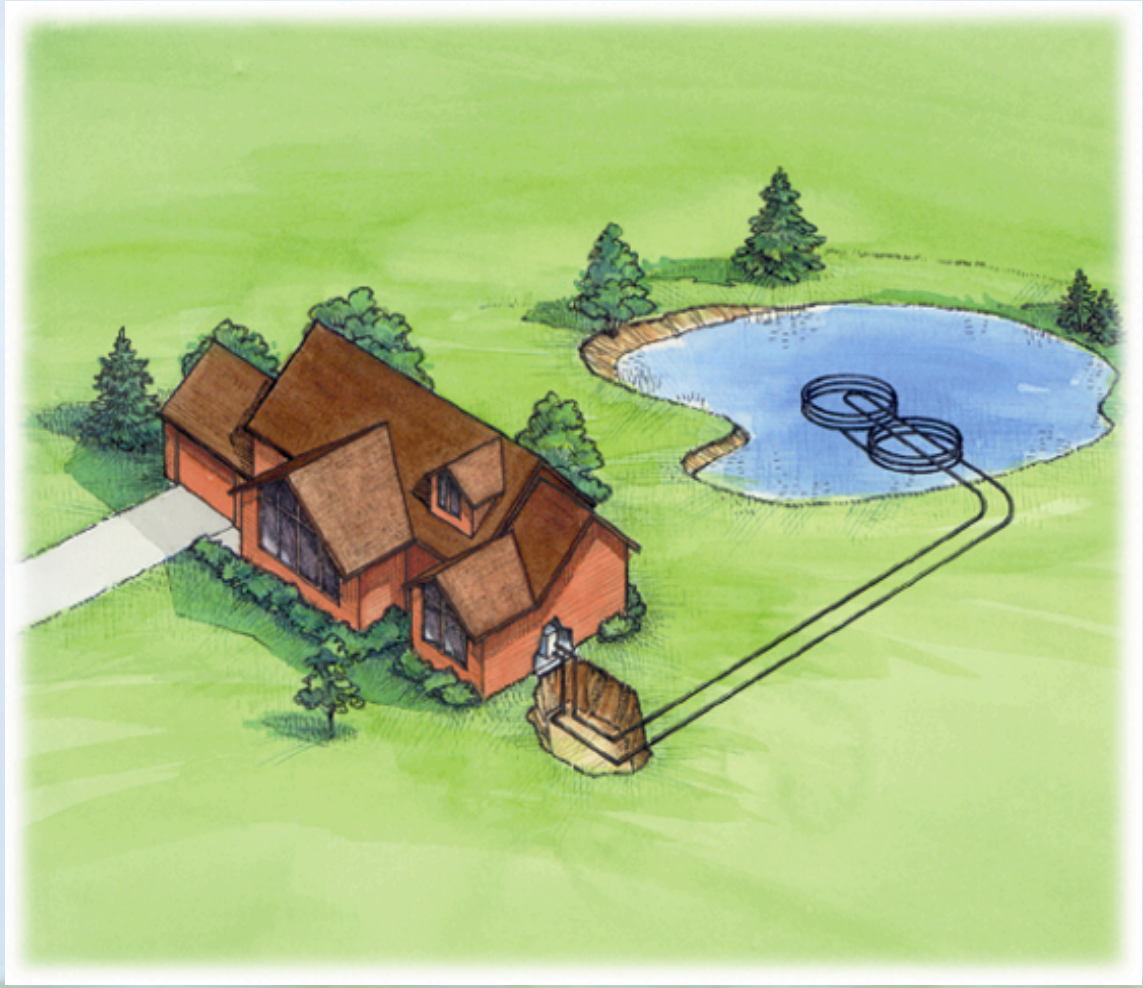
Pond Loop



Minimum ½ Acre,
8 Ft. Deep

Racked Loops

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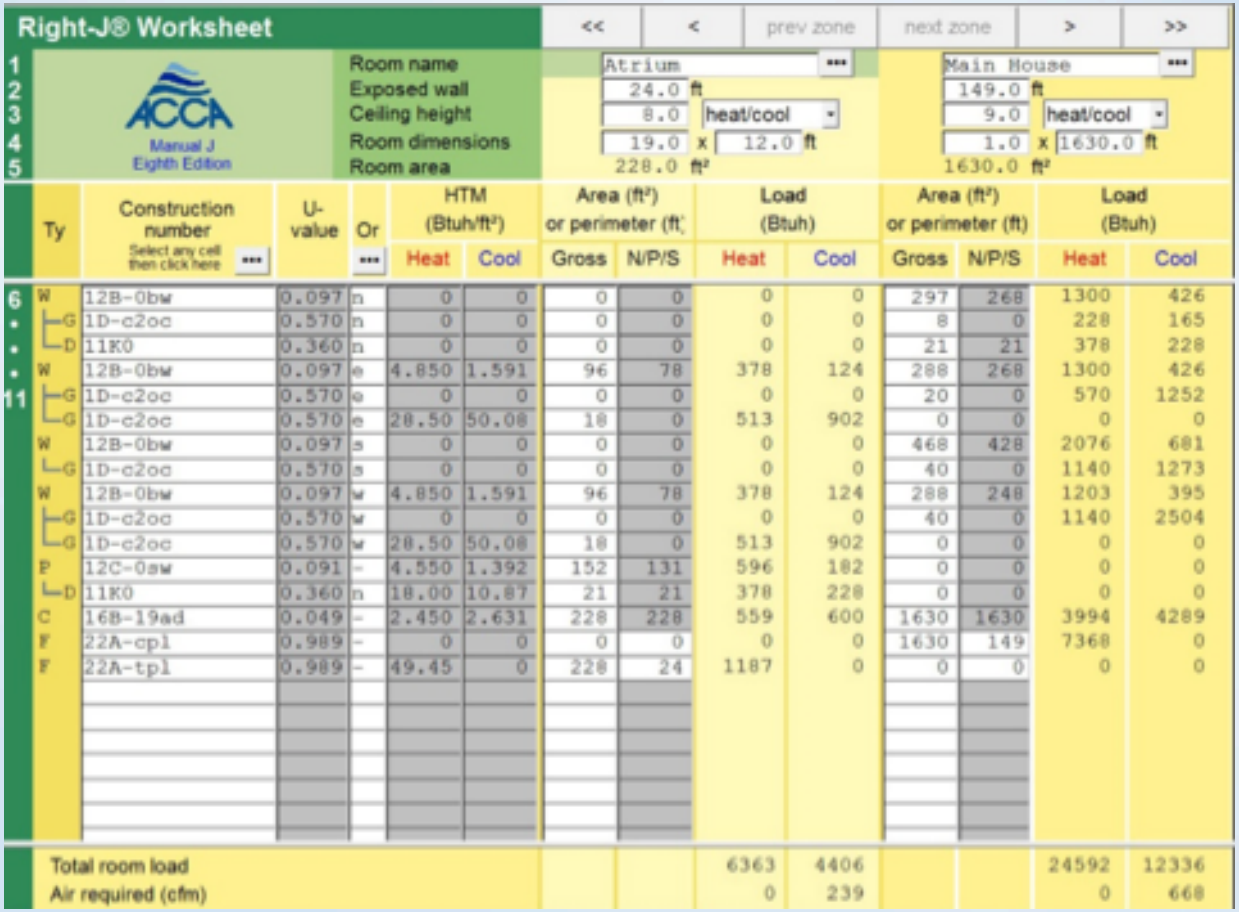
Well Water (Open Loop)

Uses
Existing Well

Load Calculation is a VITAL First Step



Right-J® Worksheet

<< | < | prev zone | next zone | > | >>

ACCA Manual J Eighth Edition

		Atrium	Main House
1	Room name	Atrium	Main House
2	Exposed wall	24.0 ft	149.0 ft
3	Ceiling height	8.0 heat/cool	9.0 heat/cool
4	Room dimensions	19.0 x 12.0 ft	1.0 x 1630.0 ft
5	Room area	228.0 ft²	1630.0 ft²

	Ty	Construction number (Select any cell then click here)	U-value	Or	HTM (Btuh/ft²) Heat	HTM (Btuh/ft²) Cool	Area (ft²) or perimeter (ft) Gross	Area (ft²) or perimeter (ft) N/P/S	Load (Btuh) Heat	Load (Btuh) Cool	Area (ft²) or perimeter (ft) Gross	Area (ft²) or perimeter (ft) N/P/S	Load (Btuh) Heat	Load (Btuh) Cool
6	W	12B-0bw	0.097	n	0	0	0	0	0	0	297	268	1300	426
	G	1D-c2oc	0.570	n	0	0	0	0	0	0	8	0	228	165
	D	11K0	0.360	n	0	0	0	0	0	0	21	21	378	228
	W	12B-0bw	0.097	e	4.850	1.591	96	78	378	124	288	268	1300	426
	G	1D-c2oc	0.570	e	0	0	0	0	0	0	20	0	570	1252
11	G	1D-c2oc	0.570	e	28.50	50.08	18	0	513	902	0	0	0	0
	W	12B-0bw	0.097	s	0	0	0	0	0	0	468	428	2076	681
	G	1D-c2oc	0.570	s	0	0	0	0	0	0	40	0	1140	1273
	W	12B-0bw	0.097	w	4.850	1.591	96	78	378	124	288	248	1203	395
	G	1D-c2oc	0.570	w	0	0	0	0	0	0	40	0	1140	2504
	G	1D-c2oc	0.570	w	28.50	50.08	18	0	513	902	0	0	0	0
	P	12C-0aw	0.091	-	4.550	1.392	152	131	596	182	0	0	0	0
	D	11K0	0.360	n	18.00	10.87	21	21	378	228	0	0	0	0
	C	16B-19ad	0.049	-	2.450	2.631	228	228	559	600	1630	1630	3994	4289
	F	22A-cpl	0.989	-	0	0	0	0	0	0	1630	149	7368	0
	F	22A-tpl	0.989	-	49.45	0	228	24	1187	0	0	0	0	0
	Total room load								6363	4406			24592	12336
	Air required (cfm)								0	239			0	668

Geothermal is a different type of heating/cooling system. Equipment cannot be oversized, nor undersized – unlike a traditional gas furnace. It must be properly sized

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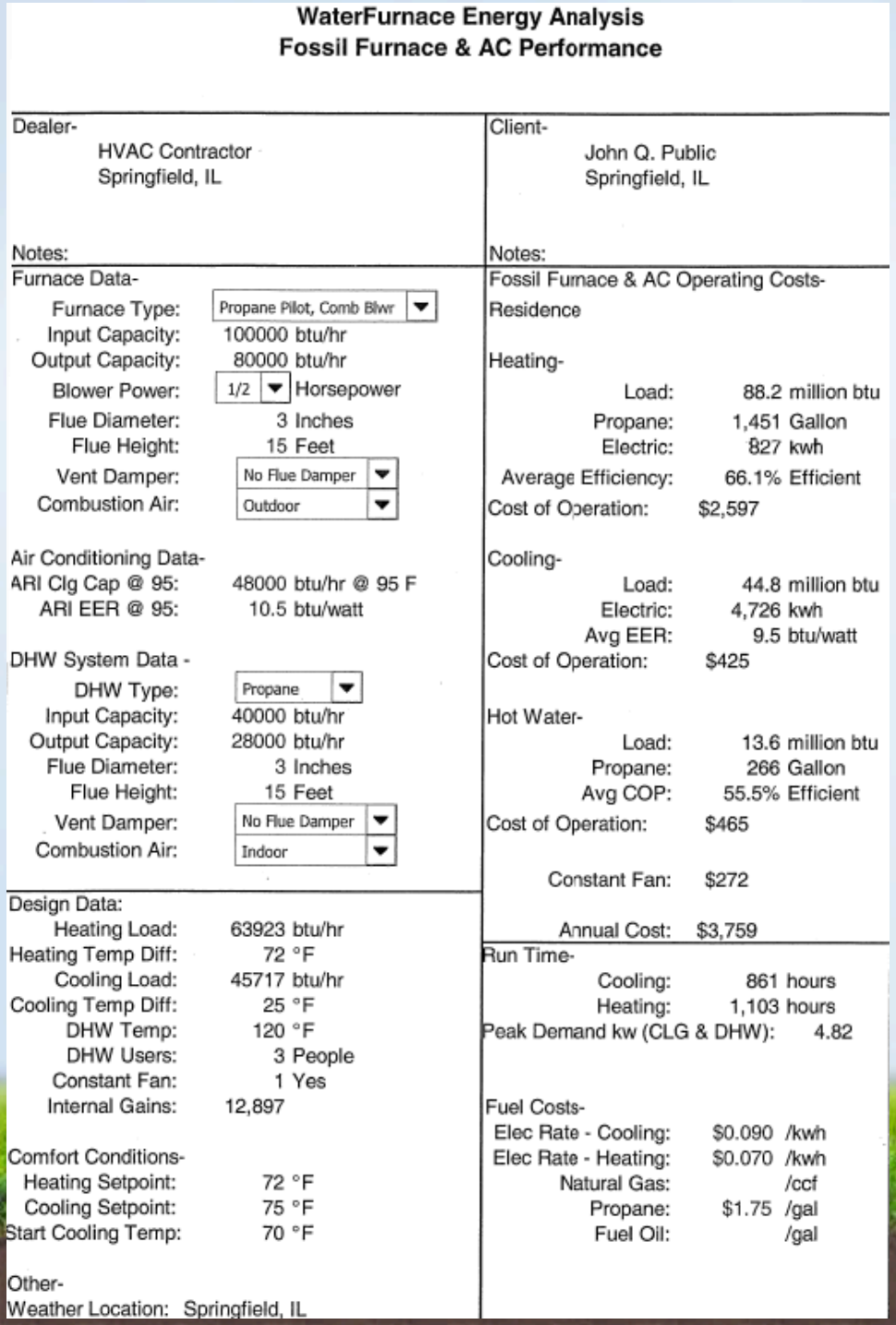

WaterFurnace Energy Analysis
Fossil Furnace & AC Performance

Dealer-
HVAC Contractor
Springfield, IL

Notes:

Client-
John Q. Public
Springfield, IL

Notes:

Furnace Data-

Furnace Type:	Propane Pilot, Comb Blwr
Input Capacity:	100000 btu/hr
Output Capacity:	80000 btu/hr
Blower Power:	1/2 Horsepower
Flue Diameter:	3 Inches
Flue Height:	15 Feet
Vent Damper:	No Flue Damper
Combustion Air:	Outdoor

Air Conditioning Data-

ARI Clg Cap @ 95:	48000 btu/hr @ 95 F
ARI EER @ 95:	10.5 btu/watt

DHW System Data -

DHW Type:	Propane
Input Capacity:	40000 btu/hr
Output Capacity:	28000 btu/hr
Flue Diameter:	3 Inches
Flue Height:	15 Feet
Vent Damper:	No Flue Damper
Combustion Air:	Indoor

Design Data:

Heating Load:	63923 btu/hr
Heating Temp Diff:	72 °F
Cooling Load:	45717 btu/hr
Cooling Temp Diff:	25 °F
DHW Temp:	120 °F
DHW Users:	3 People
Constant Fan:	1 Yes
Internal Gains:	12,897

Comfort Conditions-

Heating Setpoint:	72 °F
Cooling Setpoint:	75 °F
Start Cooling Temp:	70 °F

Other-
Weather Location: Springfield, IL

Fossil Furnace & AC Operating Costs-
Residence

Heating-

Load:	88.2 million btu
Propane:	1,451 Gallon
Electric:	827 kwh
Average Efficiency:	66.1% Efficient
Cost of Operation:	$2,597

Cooling-

Load:	44.8 million btu
Electric:	4,726 kwh
Avg EER:	9.5 btu/watt
Cost of Operation:	$425

Hot Water-

Load:	13.6 million btu
Propane:	266 Gallon
Avg COP:	55.5% Efficient
Cost of Operation:	$465

Constant Fan:	$272
Annual Cost:	$3,759

Run Time-

Cooling:	861 hours
Heating:	1,103 hours
Peak Demand kw (CLG & DHW):	4.82

Fuel Costs-

Elec Rate - Cooling:	$0.090 /kwh
Elec Rate - Heating:	$0.070 /kwh
Natural Gas:	/ccf
Propane:	$1.75 /gal
Fuel Oil:	/gal

Geothermal Sizing Software Provides an Energy Analysis

This analysis will provide energy usage projections, paybacks, savings, etc.

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Classic Geothermal Residential Retrofit in Old Home

Geothermal can work in virtually any application … some are easier than others

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Geothermal Costs & Incentives

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Group Buy

How it works:

The more people go geothermal, the lower the price:

$3,900 / Ton

Base price is lower than Design Air's market rate.

Volume Rebates

Total	50 Tons	100 Tons	150 Tons
Discount price/Ton	$3,700	$3,600	$3,500
# of Properties	8-12 homes	16-24 homes	24-36 homes

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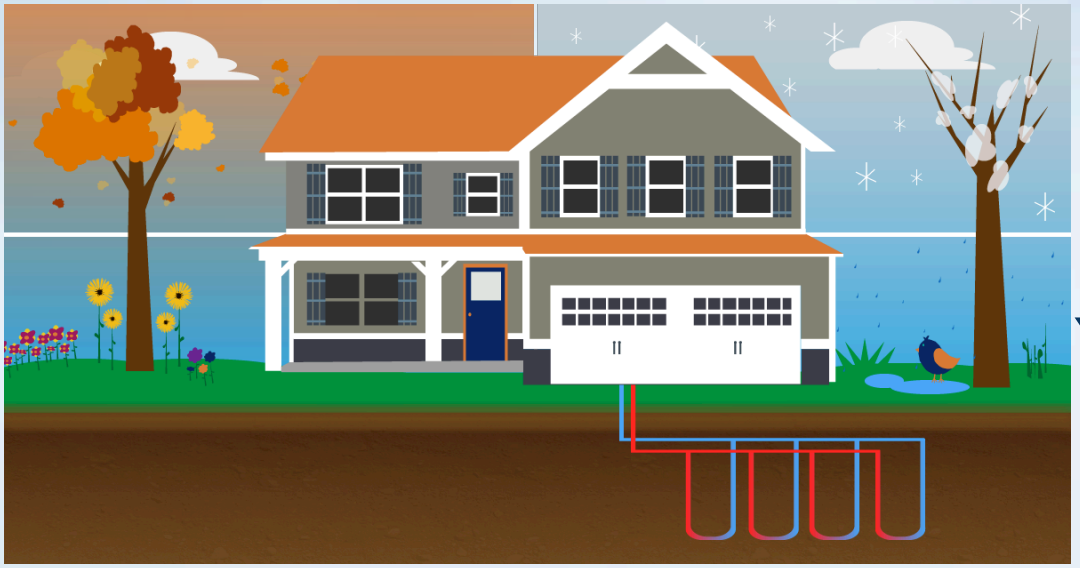

Every Home Is Different

Your Geothermal System Is Tailor-Made To Fit Your Needs

Pricing Varies by Site and Needs:

- System Design and Size
- Supplemental electric heat or gas furnace upgrade
- Geothermal hot water assist and buffer tank
- Surge Protectors

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Federal Residential & Commercial Geothermal Tax Credit

- **Tax credit of 26%** on qualified expenditures in 2020
- No maximum credit, but requires you have tax appetite
- Steps down to 22% in 2021 and 0% in 2022 (stays at 10% for commercial in ‘22 and beyond)
- A home must be owned by the taxpayer but does not have to serve as the principal residence
- Incentive details at energystar.gov or irs.gov

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Design-Air
HEATING & AIR CONDITIONING

4 Ton WaterFurnace 3 Series

10kw Supplement Heat, Wiring

and Hot Water Assist

Installed cost	$21,690
Max. Geo Urbana Champaign discount	-$1,600
26% Federal Tax Credit	- $5,223
Net cost	**$14,867**

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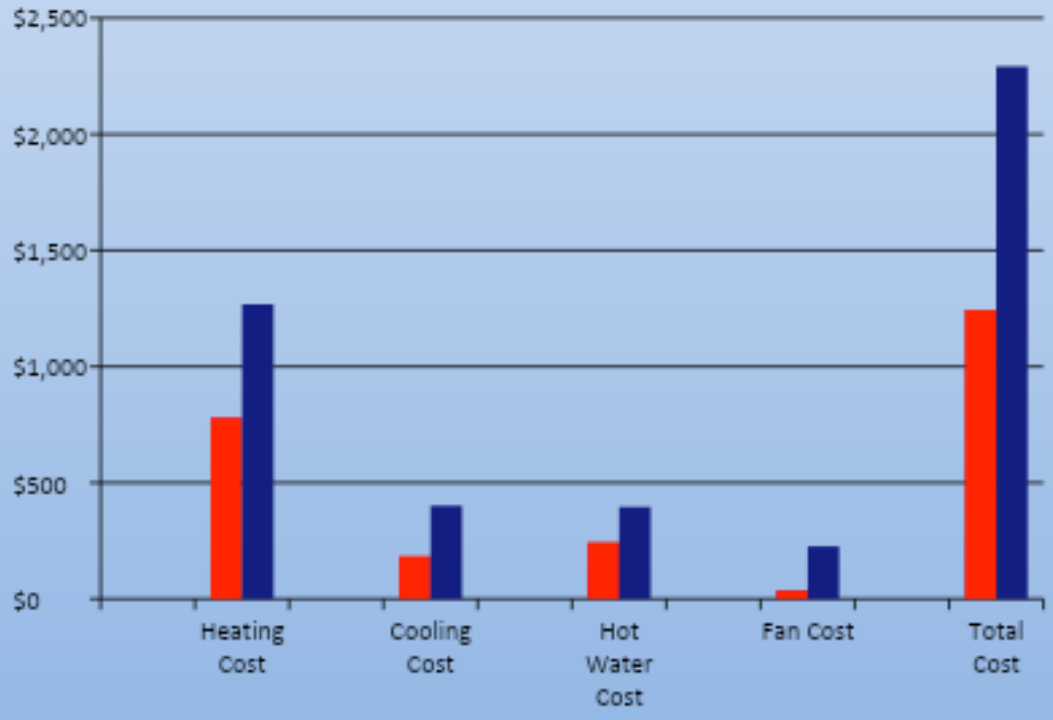
Design-Air
HEATING & AIR CONDITIONING

Reduce Your Energy Bill



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Incremental Payback

Type of System	Cost	Tax Credit	Incremental Payback
Geothermal	$20,000	$5,200	$4,800
NG or Propane Furnace and Air Conditioning	$10,000	N/A	N/A

- Home or Business requires heating and cooling
- Assumes property requires new HVAC system
- Compares geothermal against conventional equipment
- Paybacks typically in the three-six year range depending on the cost of gas, electric rates, etc.

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Home Values

Possible Reasons for Increased Resale Value:

- Immediate Monthly Savings for Buyers
- More and More Buyers Want Green Homes
- A “Low Hassle” Improvement

The amount of energy savings depends on the size of the home, the climate, and the way that the homeowner uses heating and cooling. The U.S. EPA claims that people can save as much as 70% on heating costs and 50% on cooling with geothermal heating pumps.

No home improvement is guaranteed to provide a specific ROI. Ultimately, the way a home is valued depends on the knowledge of the many parties relevant to the transaction. Real Estate agents who understand how geothermal heating and cooling works and average energy savings for the area can help to market the home appropriately.

Environmental Benefits

- Requires less fuel to heat or cool your home
  - Space heating, air consideration, and water heating account for **~ 70% of energy use** in the home according to the EIA
  - Reduces environmental damage caused by the extraction of fossil fuels
  - Takes fuel delivery trucks off the road
- Replacing outdated equipment with a more efficient geothermal system can reduce a home's CO2 emissions by **up to 80%**
  - Eliminates Carbon Monoxide risk, according to the CDC kills hundreds every year and makes thousands more sick
  - Improves indoor quality
  - Lasts longer - about 20-25 years
- Can lower carbon footprint even further by switching all of your energy use, including your heat pumps, from fossil fuel-generated solar electricity

Design-Air
HEATING & AIR CONDITIONING

FIVE EASY STEPS TO GEOTHERMAL

1	2	3	4	5
Get Started	**System Design & Pricing**	**Ground Loop Installation**	**Equipment Installation**	**Project Completion**
Sign up online	Phone Consultation Site Visit Energy Analysis Formal Proposal Contract & down payment	Permit Utility Location Group Loop Installation Inspection Backfill Cleanup	Site Preparation Inside Piping Same day replacement System Startup Accessories & details	City Inspection QA Walkthrough System Orientation Warranty & Maintenance Program Final Payment

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Next Steps

- Fill out the site assessment form. We'll send you link to the form in the chat AND in a follow-up email. You can also click the blue **sign up** button on **GeothermalUC.org**
- Design Air will provide you with a free, no obligation preliminary Geothermal Financial Analysis. This report can be via email or webinar.
- Request a detailed site assessment. Design Air will verify your design, update your quote and give you your contract.
- Sign contract with Design Air by May 30th, 2021, to participate in Geothermal Urbana-Champaign.
- Celebrate and enjoy clean energy!

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Stay Informed:
Become a Member of the MREA!

Promoting renewable energy, energy efficiency, and sustainable living through education and demonstration

- $20 Off All Courses
- Invite to Virtual Membership Meeting
- Access to Clean Energy Credit Union
- Subscription to Newsletter
- Free Online Tutorials
- Free Rise Up! Publication Mailed to You

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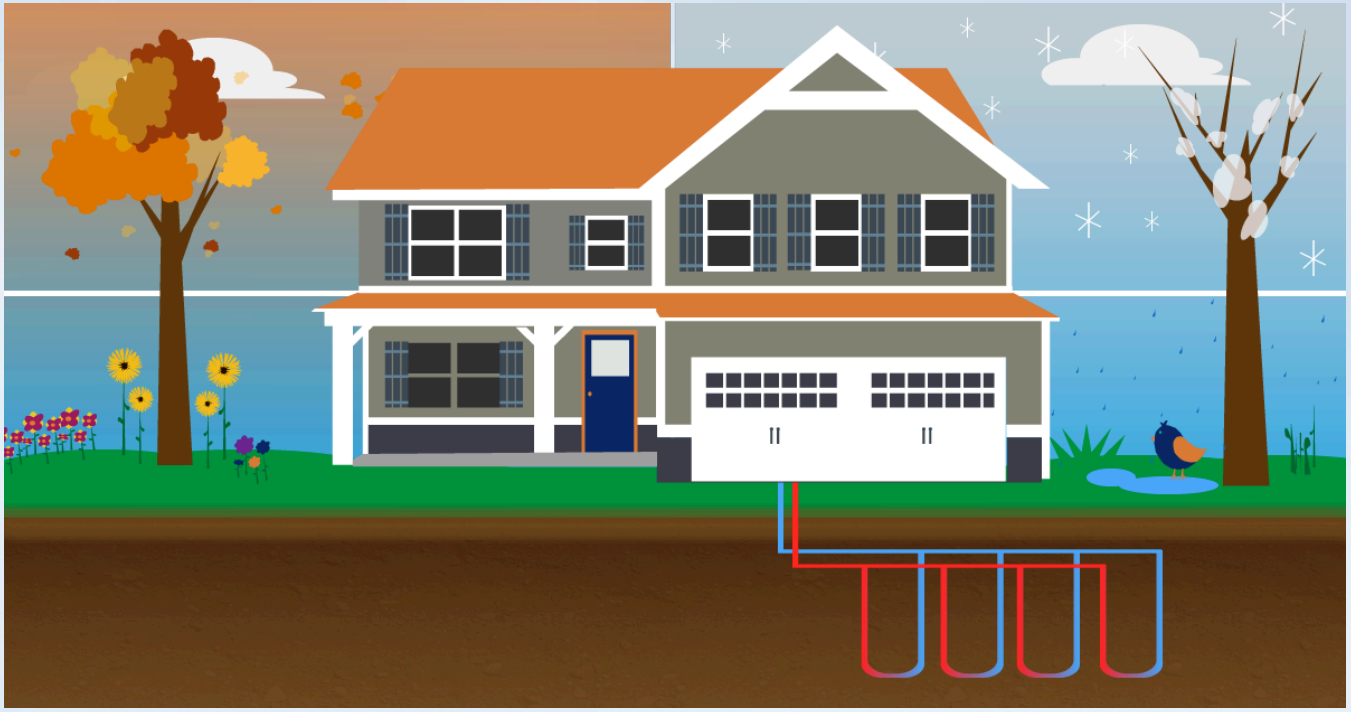
Geothermal Alliance of Illinois



www.GeothermalUC.org

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Design-Air Contact Information

Sign Up for a Site Assessment of Your Home (link is in Chat)

Reach Out: Jim Hall

JHall@DesignAirHVAC.com

Get More Information:

DesignAirHVAC.com

217-429-1105

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Thank You for Attending!

Presenter: John Freitag, Executive Director
Geothermal Alliance of IL JFreitag@gaoi.org

Feedback? Questions?

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PeterM@midwestrenew.org

www.GeothermalUC.org

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