TED TALK: ECO-EDITION

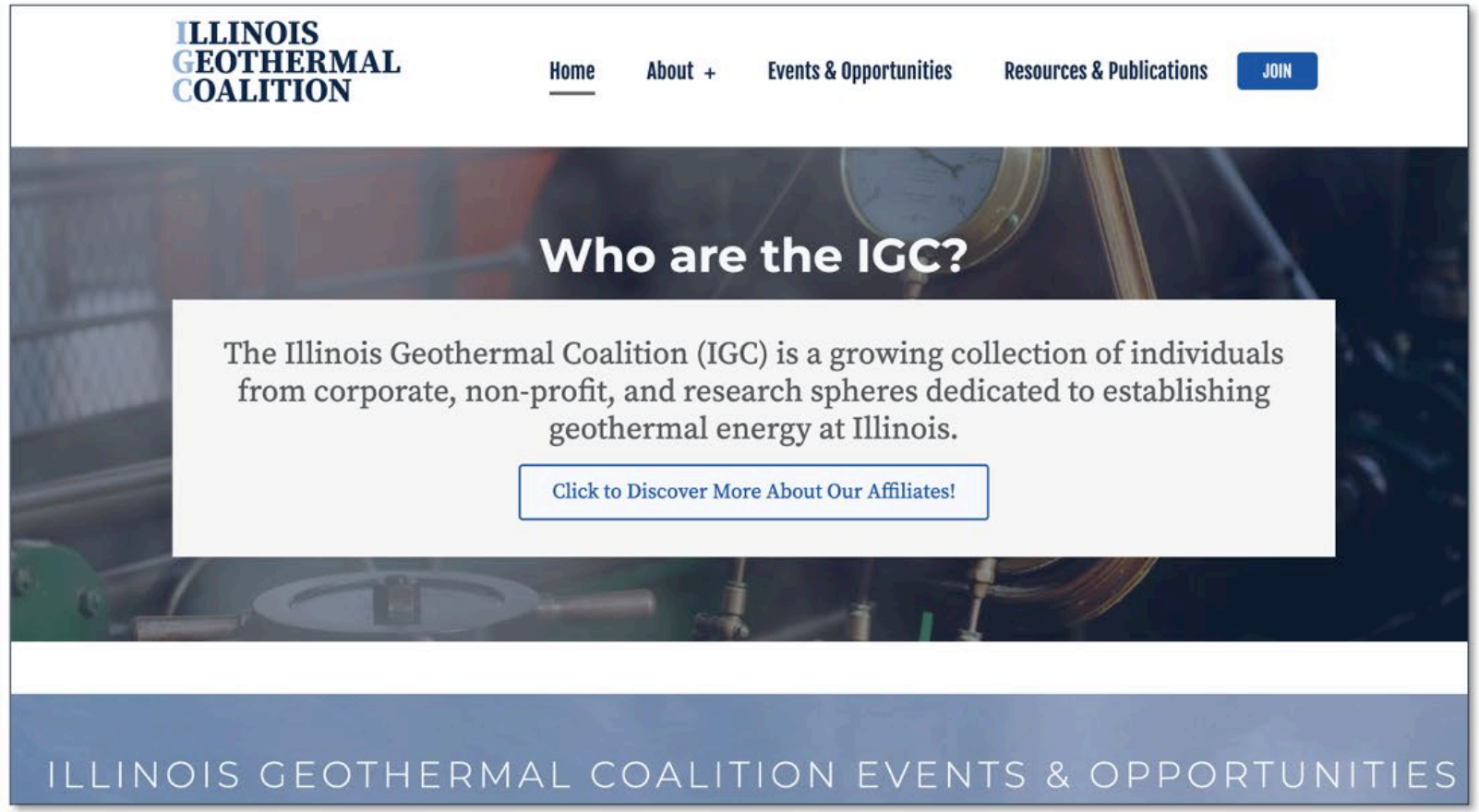
SEPT. 19 @6 P.M.

Topic: Geothermal Energy

Hosts: Andy Stumpf, Principal Research Scientist and Geologist in the Prairie Research Institute and co-founder of the Illinois Geothermal Coalition
and
Tugce Baser, Assistant Professor in Civil and Environmental Engineering, specializing in Geotechnical Engineering


Illinois
GEOTHERMAL
COALITION
Technical and Educational
Outreach Program
Illinois
Extension

Illinois Geothermal Coalition



https://geothermal.illinois.edu

Networks and Partnerships

- Illinois Geothermal Coalition
- Institute for Sustainability, Energy, and Environment (iSEE)
- Illinois Water Resources Center
- Geothermal Alliance of Illinois
- International Ground Source Heat Pump Association (IGSHPA)
- The GeoExchange Organization
- Prairie Rivers Network
- Citizens Utility Board
- Illinois Clean Jobs Coalition
- Midwest Building Decarbonization Coalition (MBDC)

Extension Collaboration Grant

PIs
Dr. Andrew Stumpf, Illinois State Geological Survey astumpf@illinois.edu
Jay Solomon, Natural Resources, Energy, and Environment, Illinois Extension jssolomo@illinois.edu

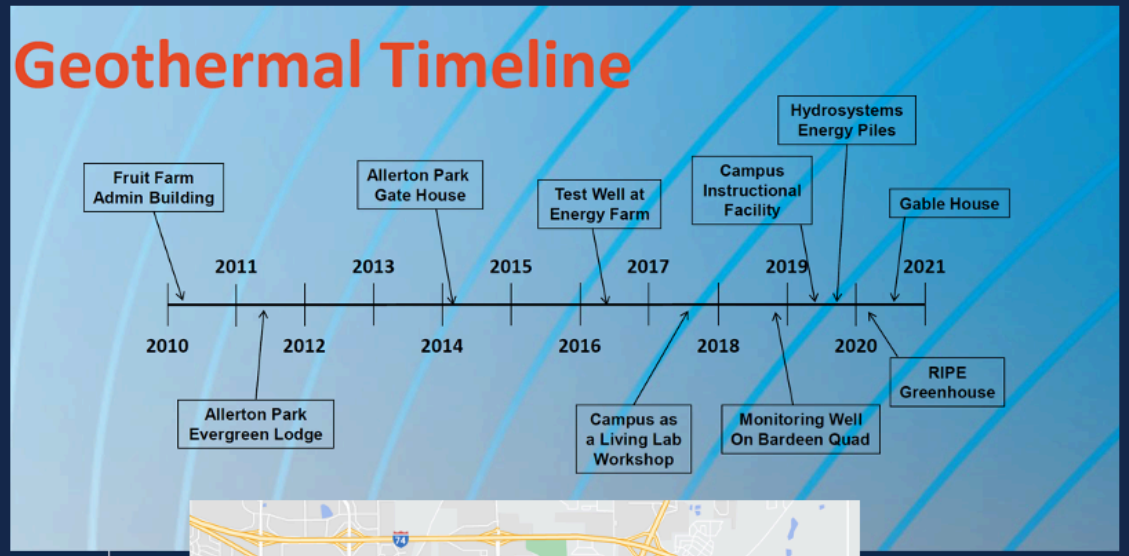
Co-PIs
Dr. Tugce Baser, Geotechnical Engineering, Civil and Environmental Engineering tbaser@illinois.edu
Nancy Ouedraogo, Community and Economic Development, Illinois Extension esarey@Illinois.edu

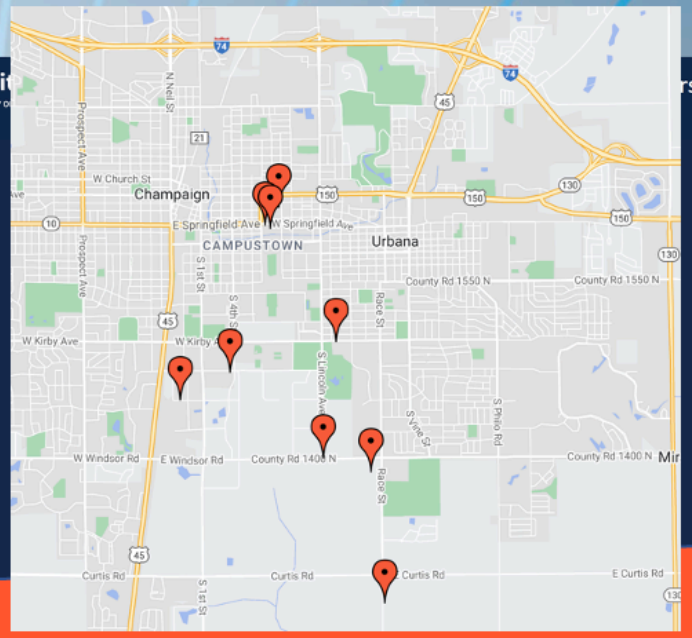
Illinois Geothermal Coalition, University of Illinois at Urbana-Champaign
https://geothermal.illinois.edu/

Illinois Extension

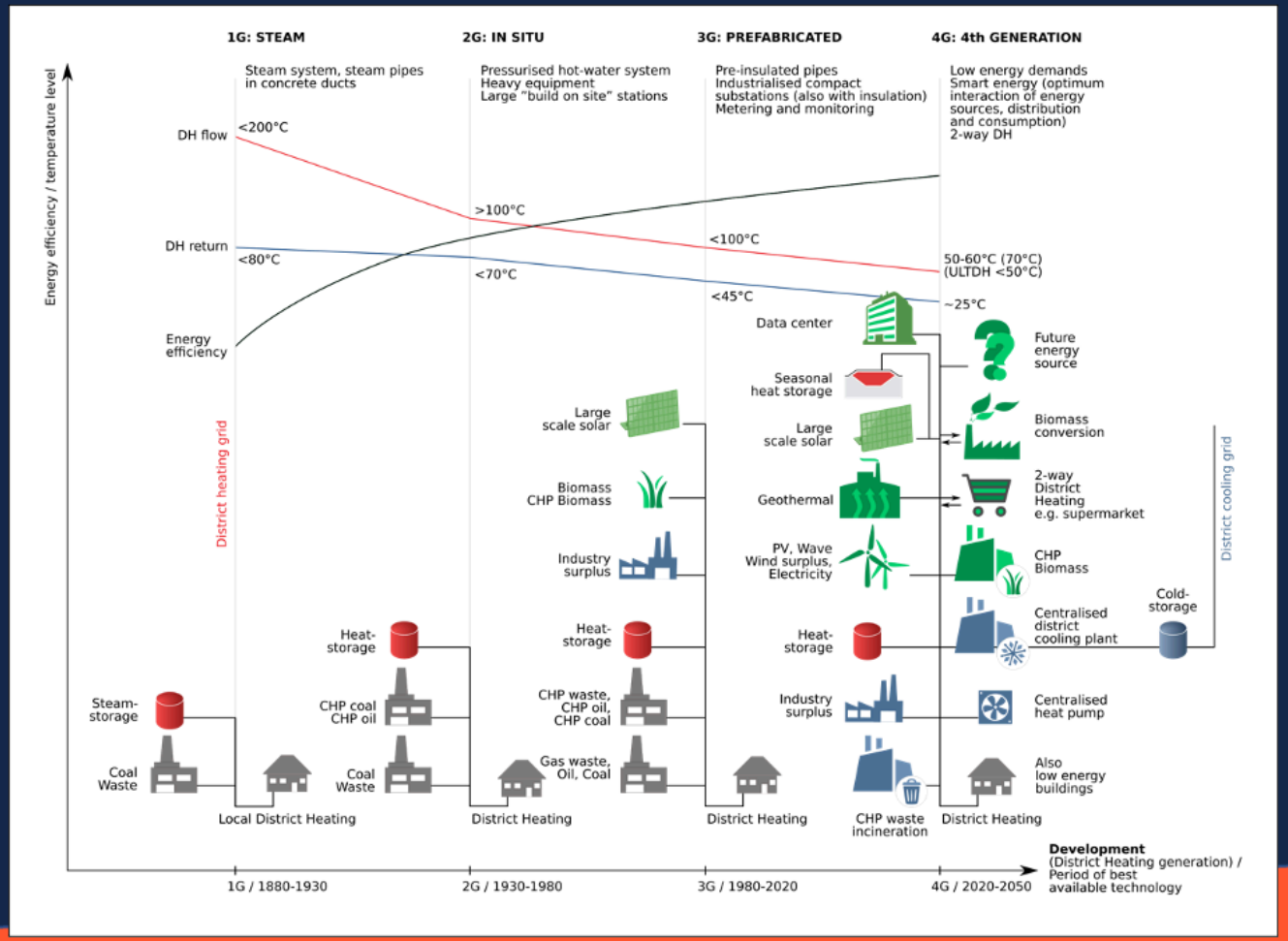
ILLINOIS
GEOTHERMAL COLLABORATION PROJECT

Current state of Geothermal at U of I and path forward





What is next?



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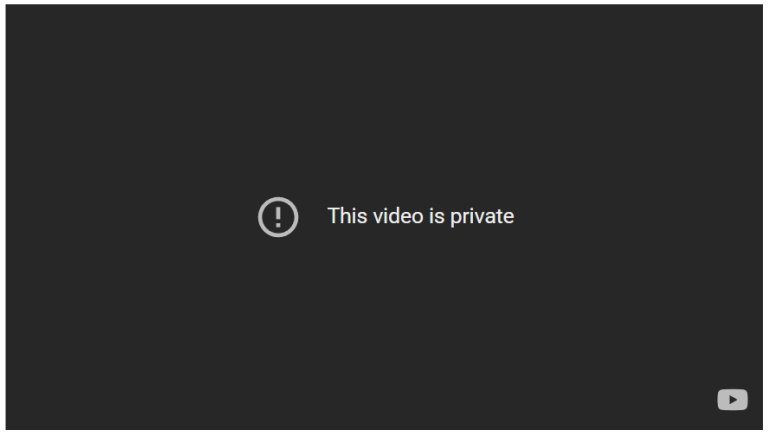
« Sierra Club Gives College Basketball Clean Energy Boost | Main | Divestment at UNC: A History of Social Justice »

02/27/2012

Geothermal Study Provides Promise for Your Campus

By Suhail Barot and Emily Cross, University of Illinois-Urbana-Champagne



In October, Google released the results of a nearly half a million dollar grant to the Southern Methodist University (SMU) Geothermal Lab, creating the most detailed geothermal maps to date. Not only did the researchers add tens of thousands of new thermal data points, but it also painted a very different picture of the potential for this clean energy that colleges nationwide can access.

The maps developed by SMU depict the heat flow of the geology in North America. When heat flows through the ground, like in water and rocks, it is possible to tap into that energy. Geothermal power plants work like normal power plants - except without burning any fuels. After piping down into the earth to capture hot water and steam, plants use this energy to push a turbine that is connected to a generator.

So what's so special about the maps that Google commissioned? Using previously unattainable data and looking at the energy flow in a more detailed manner, researchers at SMU developed a heat flow map that shows potential in areas that were once considered inaccessible. It looked at energy that could be accessed with new technologies, like tapping into heat deep below ground, even those with relatively low temperatures.

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A New Geothermal Map of the United States

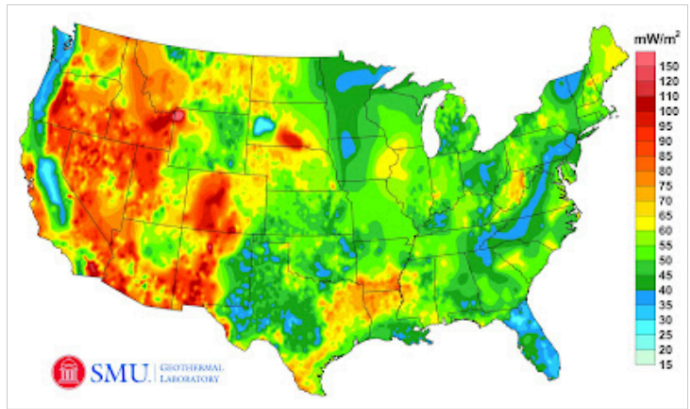
Tuesday 10/25/2011 09:03:00 AM

(Cross-posted from the Google Green blog)

Imagine a renewable energy resource capable of producing more than 10 times the energy of the installed capacity of coal in the US. That's the potential for Geothermal Energy in the United States, according to a recently completed 3-year project supported by Google.org to update the Geothermal Map of North America.

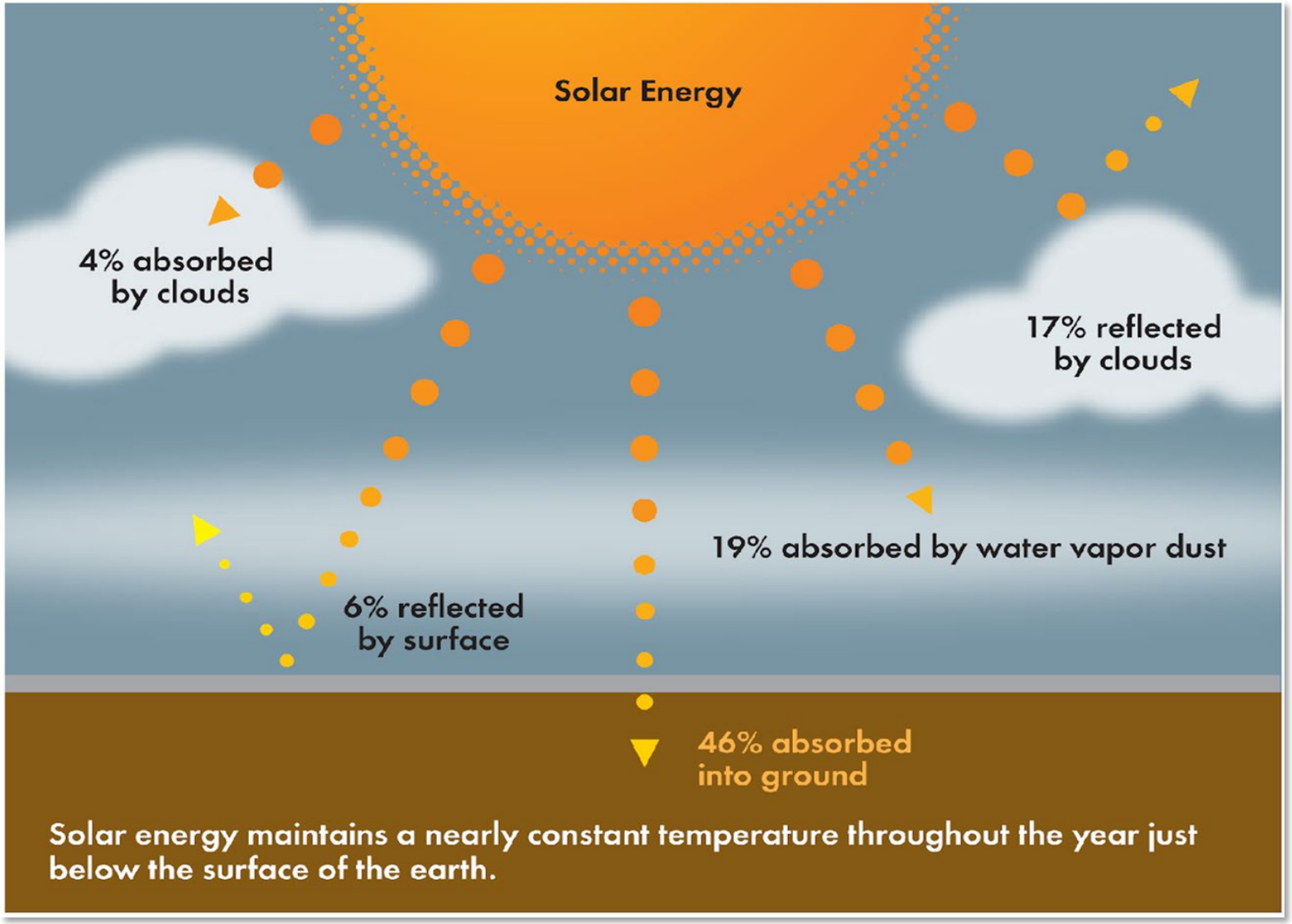
The study conducted by SMU Geothermal Laboratory, led by Principal Investigator Dr. David Blackwell, incorporated tens of thousands of new thermal data points to create the most data rich perspective on US geothermal resources to date. The full results can be seen in the updated Google Earth layer on U.S. Geothermal Resources and in SMU's paper to be presented at the Geothermal Resources Council Annual Meeting.

The project estimates that Technical Potential for the continental US exceeds 2,980,295 megawatts using Enhanced Geothermal Systems (EGS) and other advanced geothermal technologies such as Low Temperature Hydrothermal.

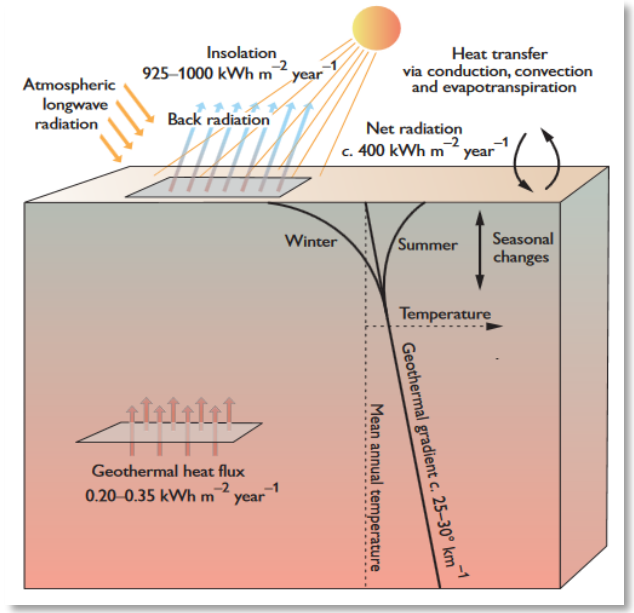


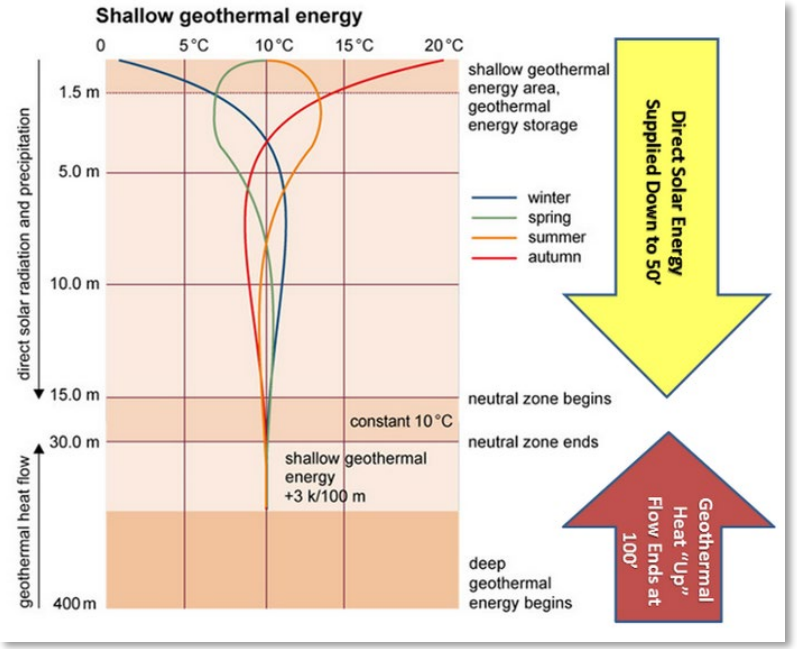
2011 Geothermal Heat Flow Map of the US

Earth is a **BIG** Solar Collector



Courtesy GAOI



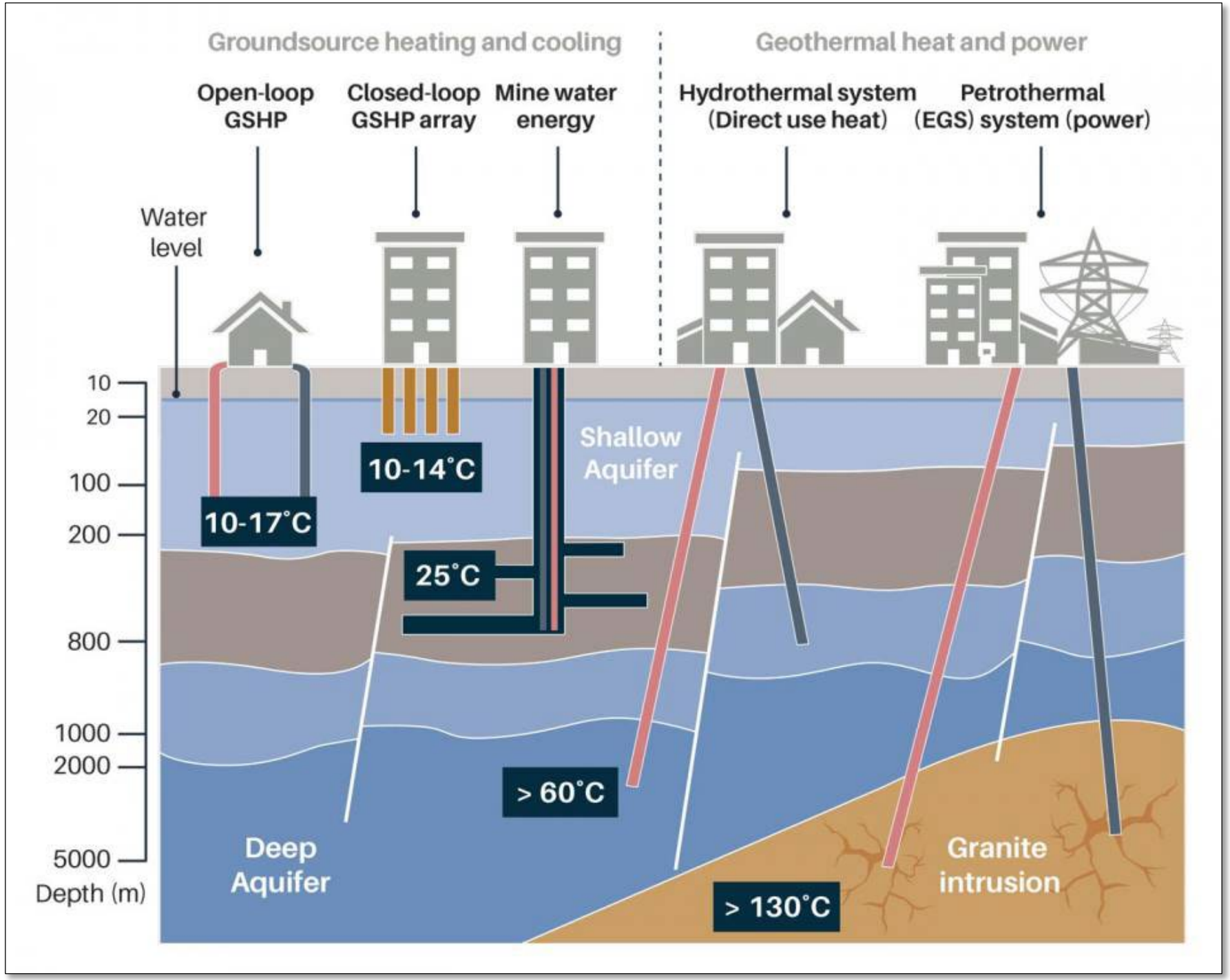


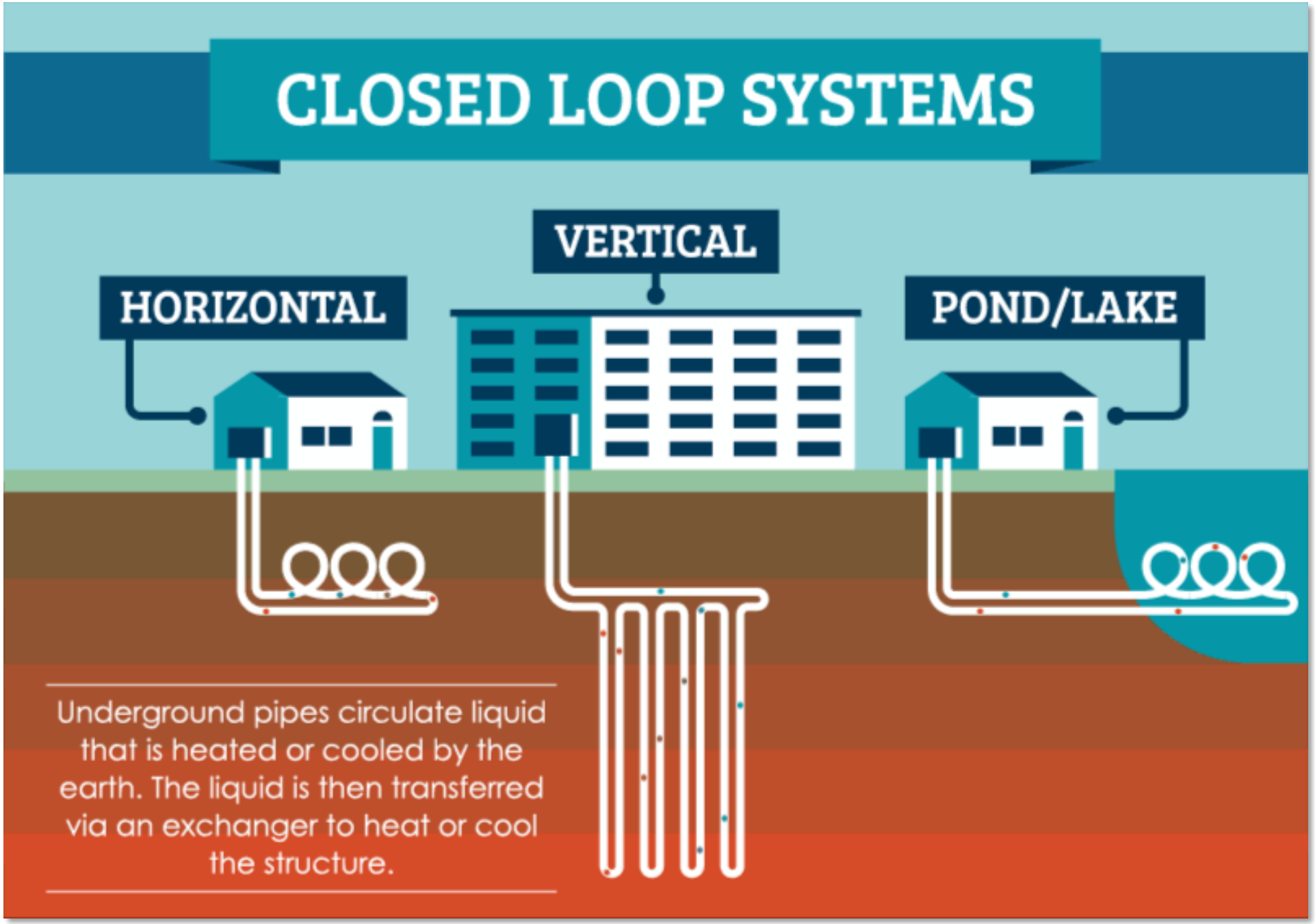
Courtesy Geological Survey of Denmark and Greenland

What is Deep Direct-Use?

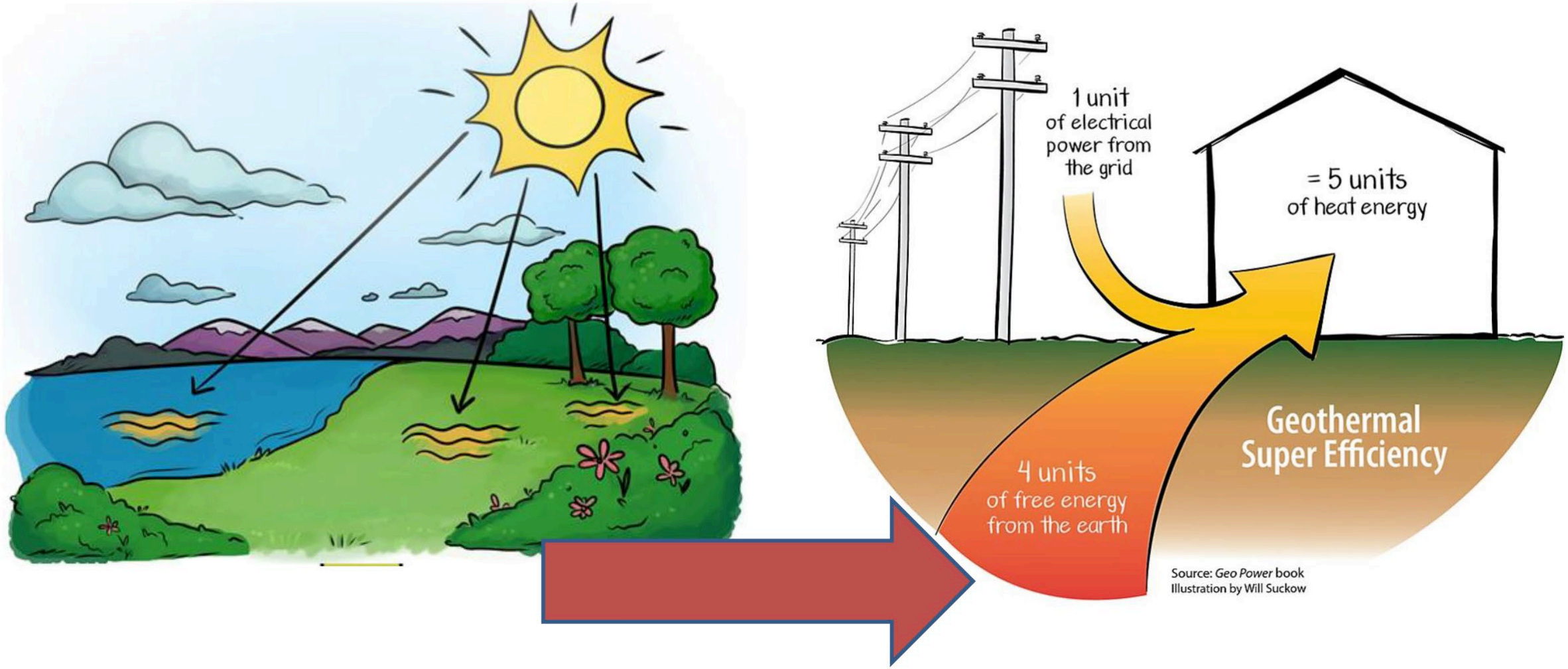
Geothermal Heat Pumps/ Ground Source Heat Pumps	Use relatively constant temperature of the earth as heat sink/source for commercial/residential heating and cooling	• Near ambient temperatures (~40-80°F) • Shallow depths - trenches to wells hundreds of feet deep
Deep Direct-Use Geothermal Energy	Use thermal energy (heat) from the earth directly for heating/cooling buildings, greenhouses, aquaculture, pools, spas, etc.	• Moderate temperatures (100-300°F) • Wells hundreds to thousands of feet deep
Geothermal Power (Electricity Generation)	Use thermal energy (heat) from the earth to generate electricity	• High temperatures (>300°F) • Wells hundreds to thousands of feet deep • Baseload generation

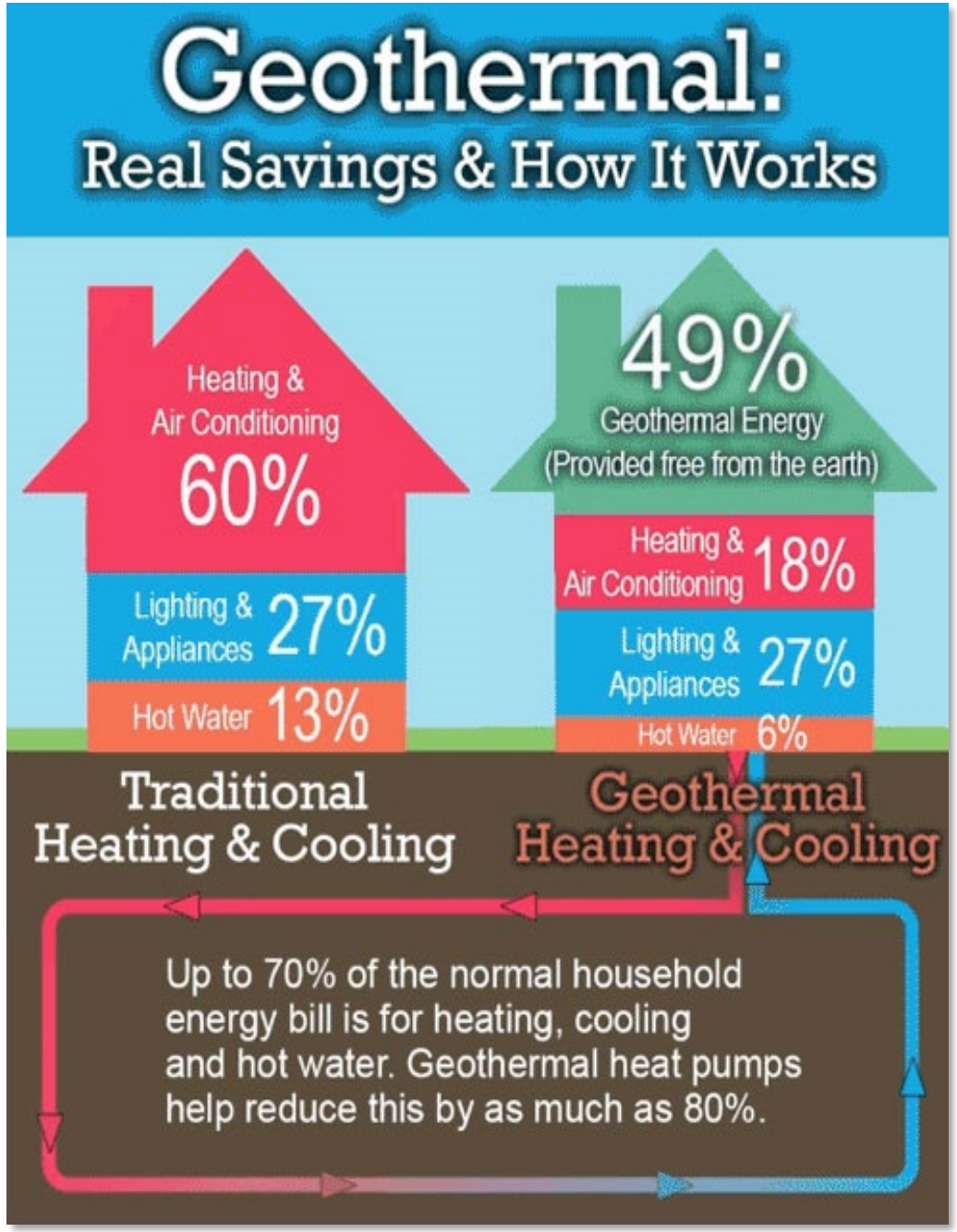
Courtesy West Virginia University

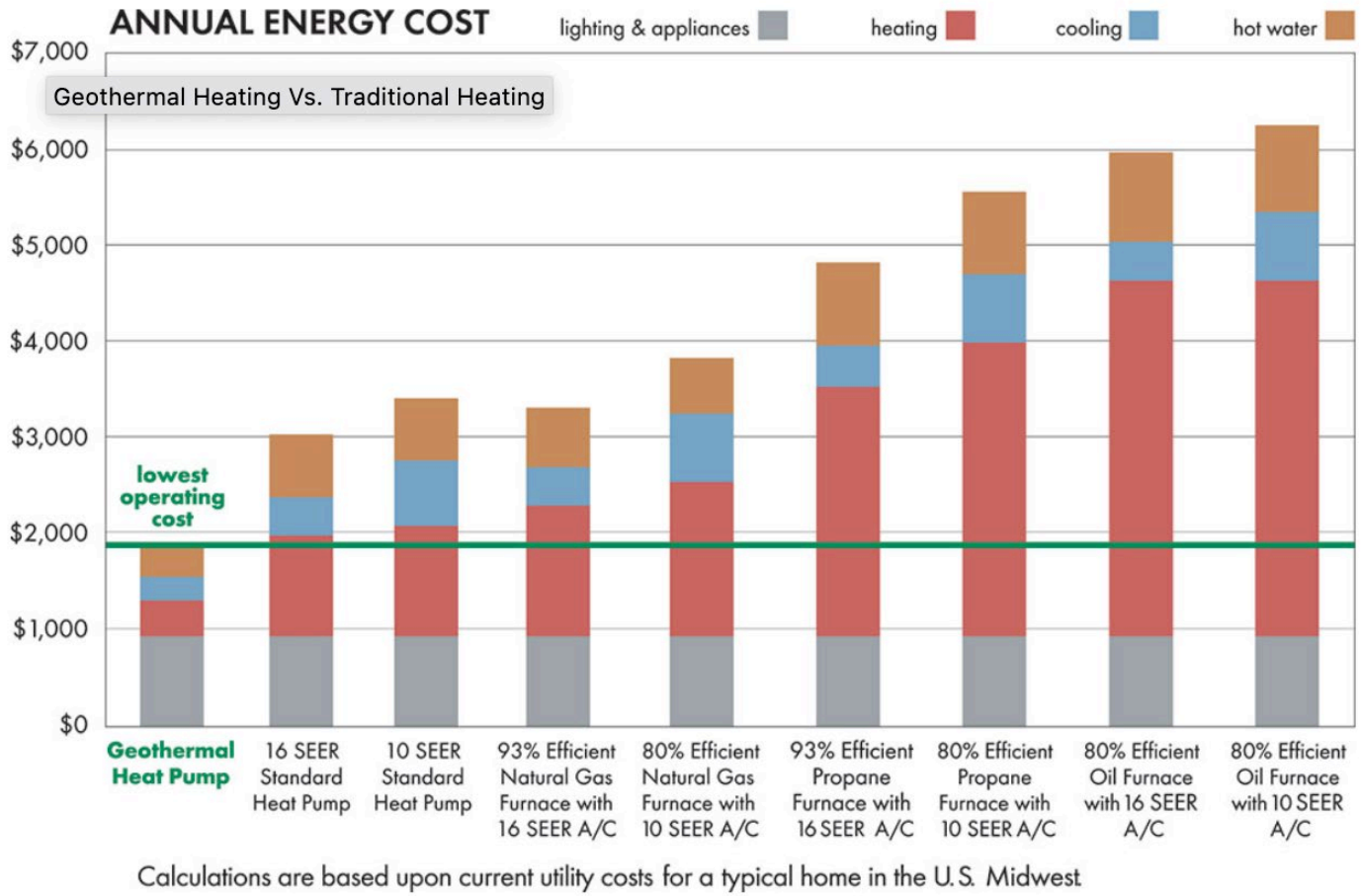

Groundsource heating and cooling
Geothermal heat and power
Open-loop GSHP
Closed-loop GSHP array
Mine water energy
Hydrothermal system (Direct use heat)
Petrothermal (EGS) system (power)
Water level
10
20
100
200
800
1000
2000
5000
Depth (m)
10-17˚C
10-14˚C
25˚C
Shallow Aquifer
> 60˚C
Deep Aquifer
> 130˚C
Granite intrusion


CLOSED LOOP SYSTEMS
VERTICAL
HORIZONTAL
POND/LAKE
Underground pipes circulate liquid that is heated or cooled by the earth. The liquid is then transferred via an exchanger to heat or cool the structure.

We Harvest Solar Energy with a GHP



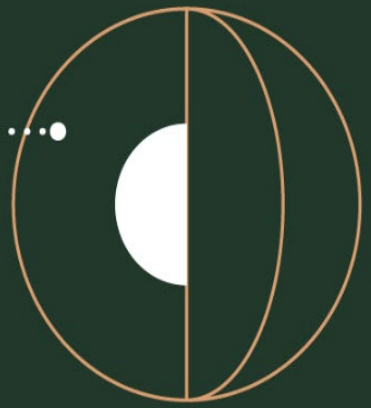




Calculations are based upon current utility costs for a typical home in the U.S. Midwest.

GEOTHERMAL ENERGY

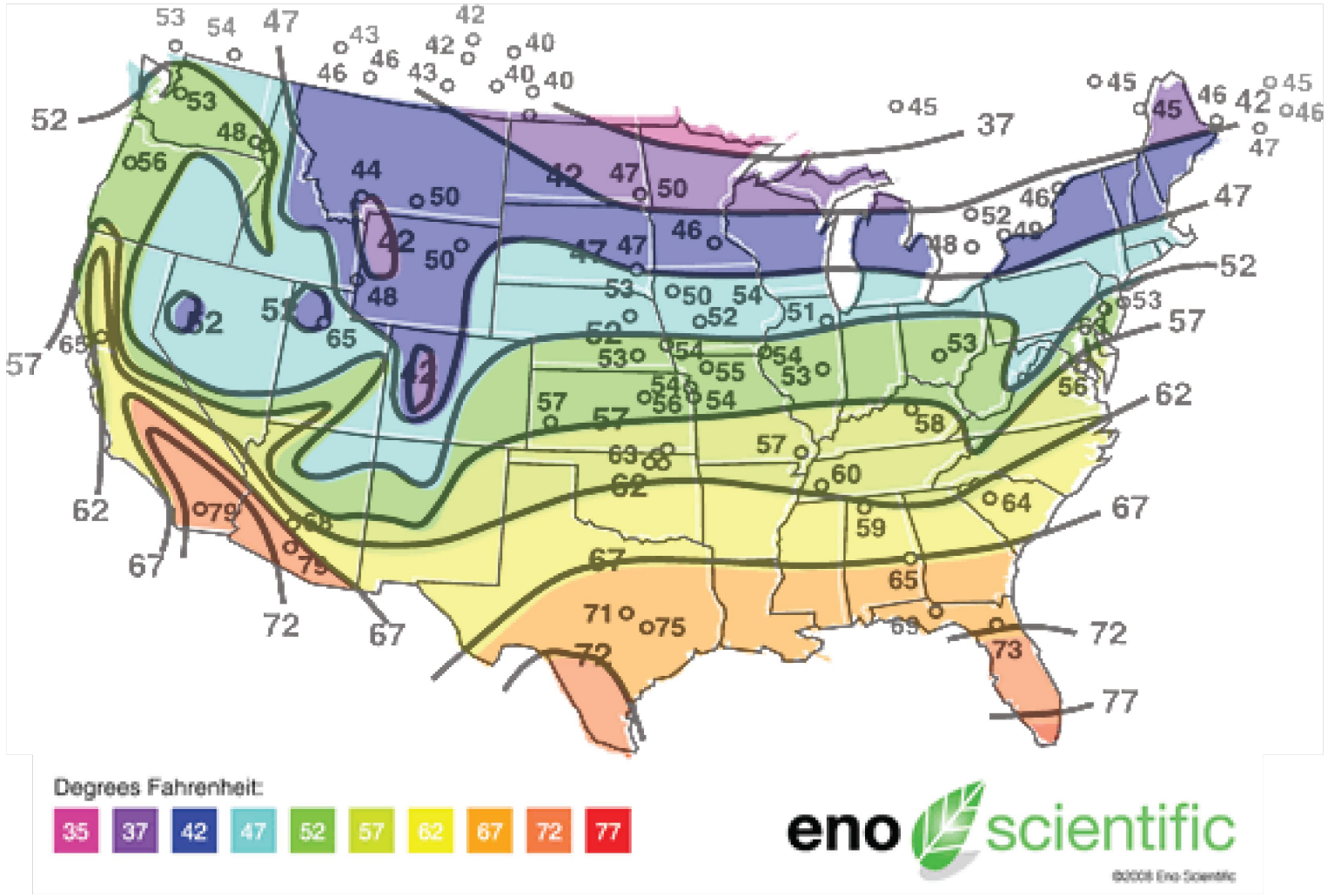
Renewable heat energy harnessed from deep beneath the surface of the earth.



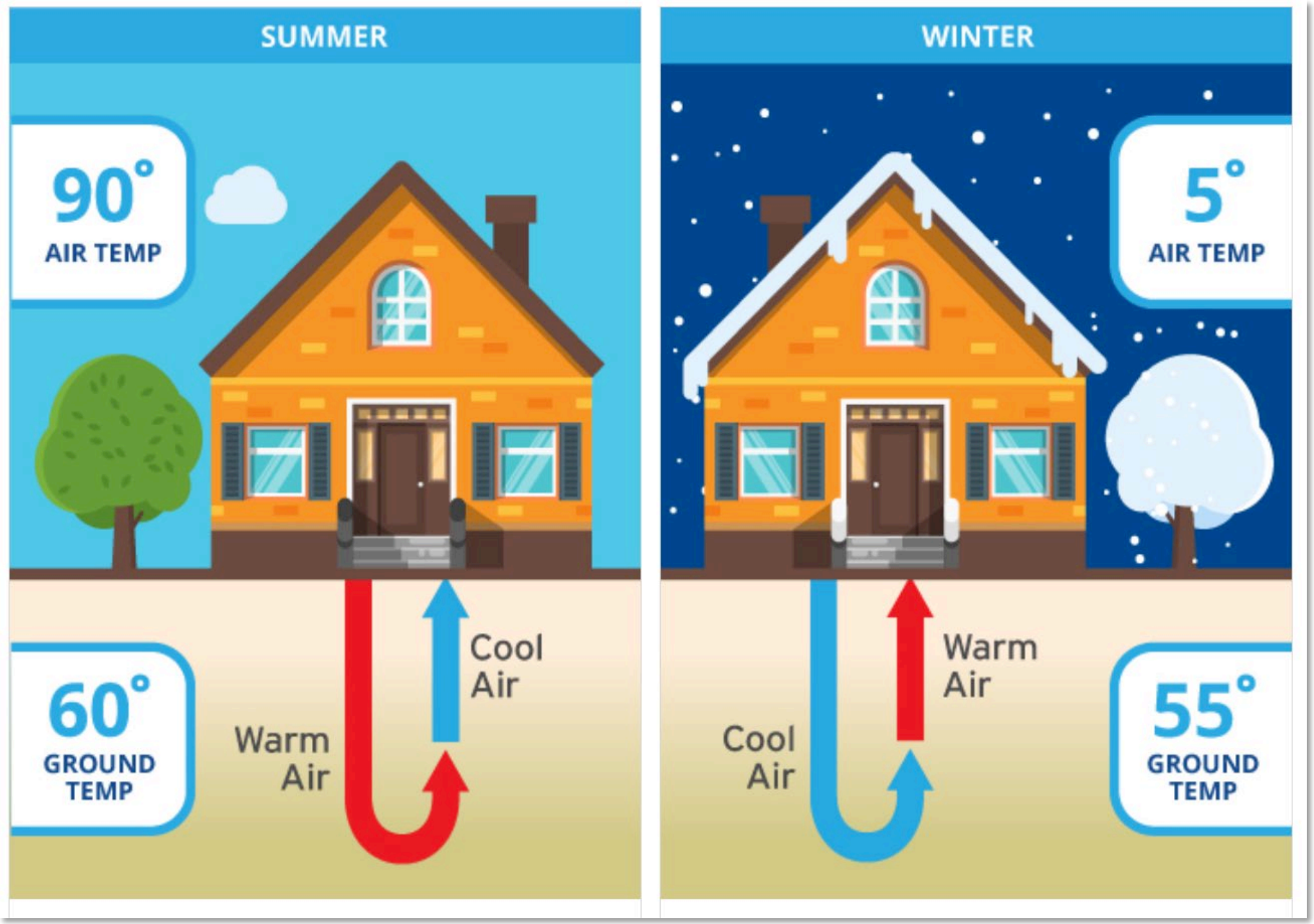
- A SUSTAINABLE RESOURCE
- MINIMAL VISUAL IMPACT
- VIRTUALLY ZERO CO_2 EMISSIONS
- UNAFFECTED BY CLIMATIC CONDITIONS

ENERGY THAT *Works* AROUND THE CLOCK

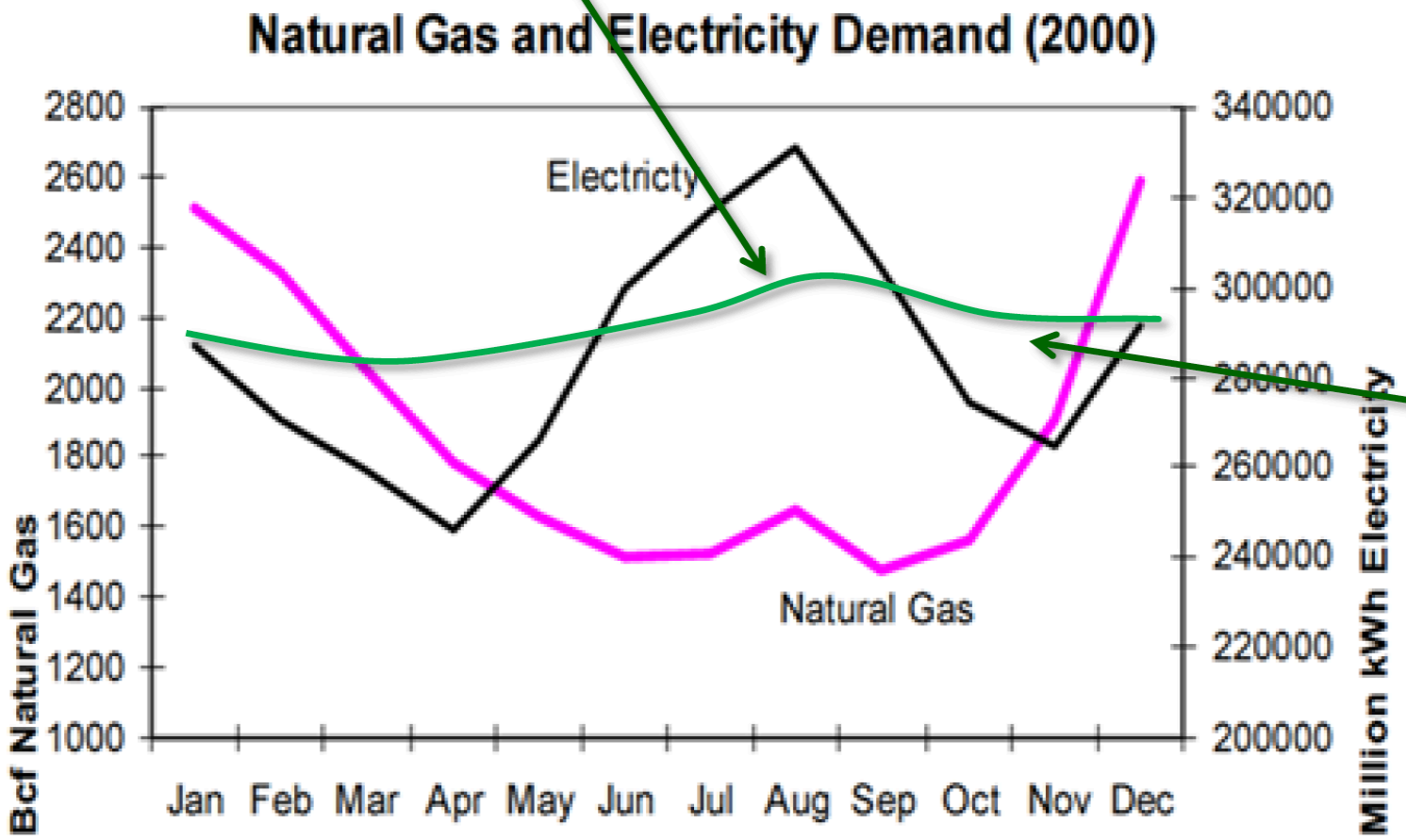
Geothermal is a reliable, baseload energy source. It can provide power *24* hours a day, *365* days a year, independent of weather conditions and with the flexibility to meet consumer demand.



In Illinois, the ground temperatures below 20 feet remains constant between 50 – 60 °F year-round. Geothermal systems are designed to take advantage of these moderate temperatures in the ground to boost energy efficiency and reduce the operational costs of heating and cooling systems.


SUMMER
90°
AIR TEMP
60°
GROUND
TEMP
Warm
Air
Cool
Air
WINTER
5°
AIR TEMP
Cool
Air
Warm
Air
55°
GROUND
TEMP

With GHP Technology, we eliminate peaks, and add load in the Winter (Levels the Grid)

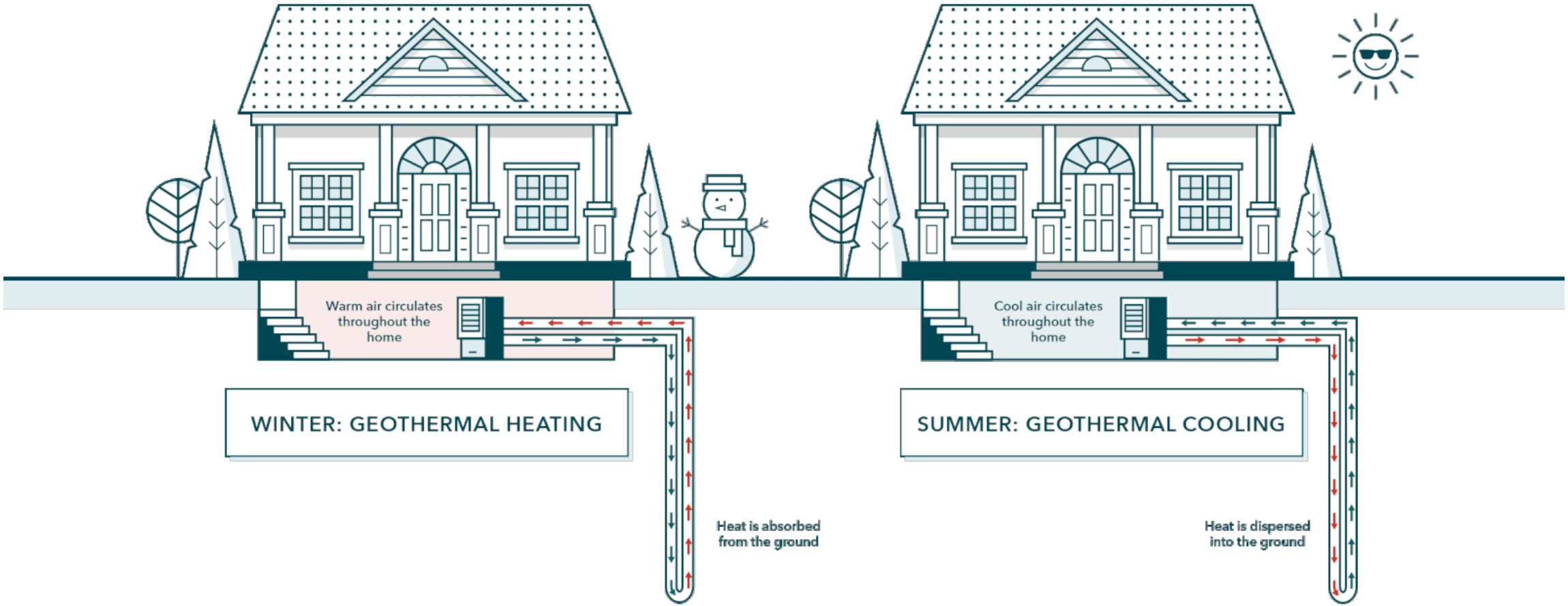


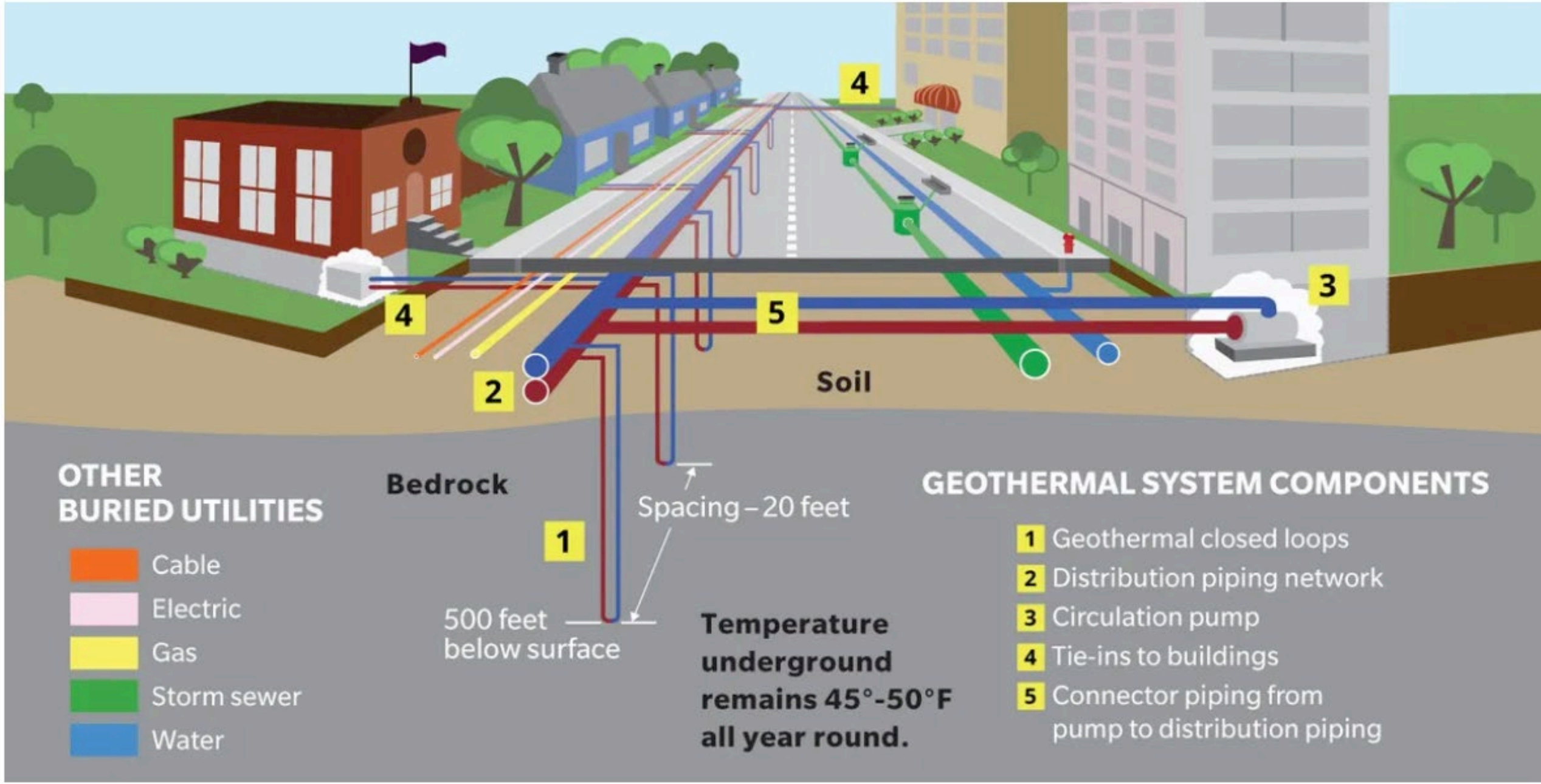
Ref: Gas Technology Institute, GRI 03/0173

A Geothermal System:

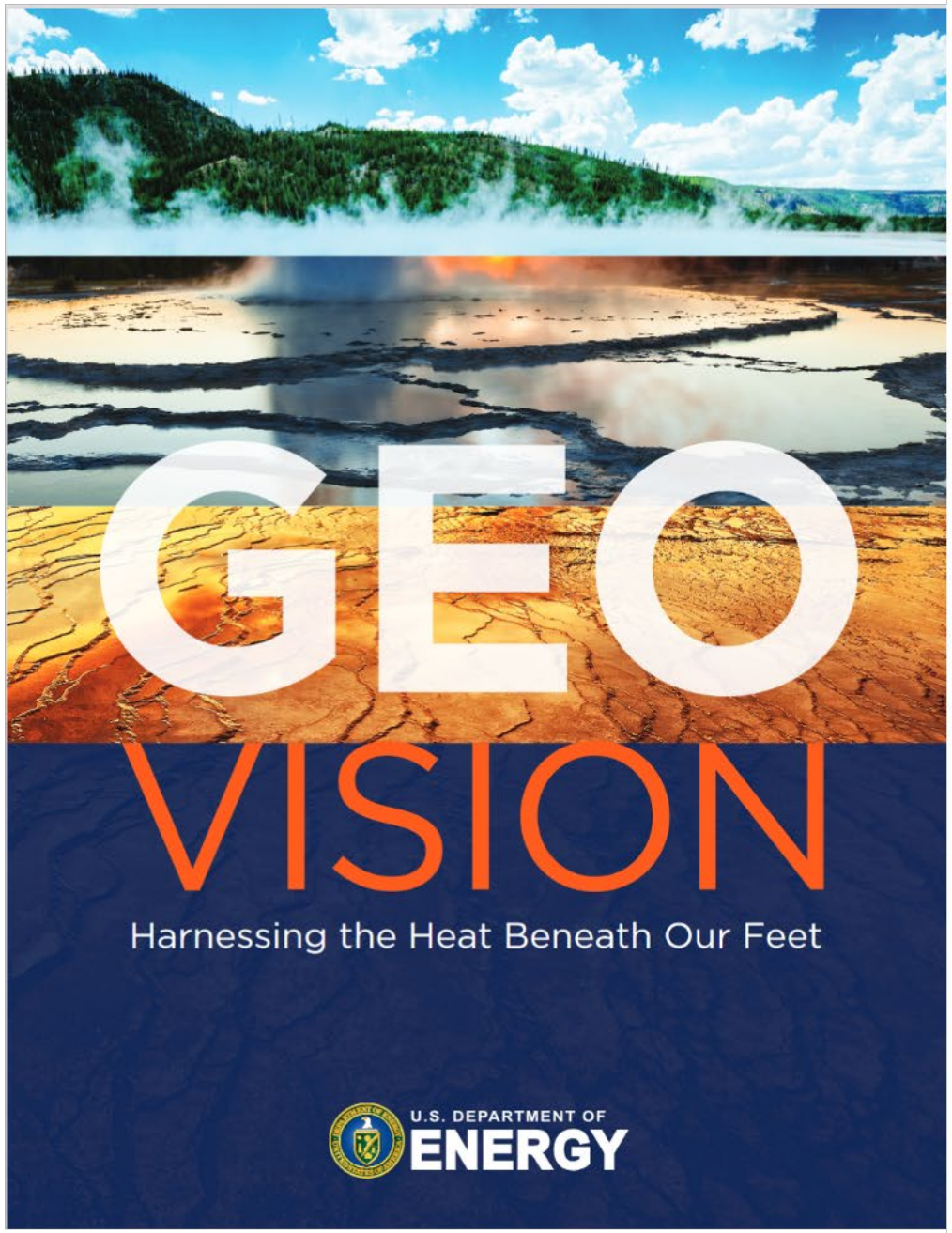
- **Reduces Summer Peak Electric Load**
- **Adds Winter Base Electric Load**

Makes good use of existing electrical infrastructure


Warm air circulates throughout the home
WINTER: GEOTHERMAL HEATING
Heat is absorbed from the ground
Cool air circulates throughout the home
SUMMER: GEOTHERMAL COOLING
Heat is dispersed into the ground


4
4
5
3
2
Soil
Bedrock
1
Spacing – 20 feet
500 feet
below surface
OTHER
BURIED UTILITIES
Cable
Electric
Gas
Storm sewer
Water
Temperature
underground
remains 45°-50°F
all year round.
GEOTHERMAL SYSTEM COMPONENTS
1 Geothermal closed loops
2 Distribution piping network
3 Circulation pump
4 Tie-ins to buildings
5 Connector piping from
pump to distribution piping

(Eversource)



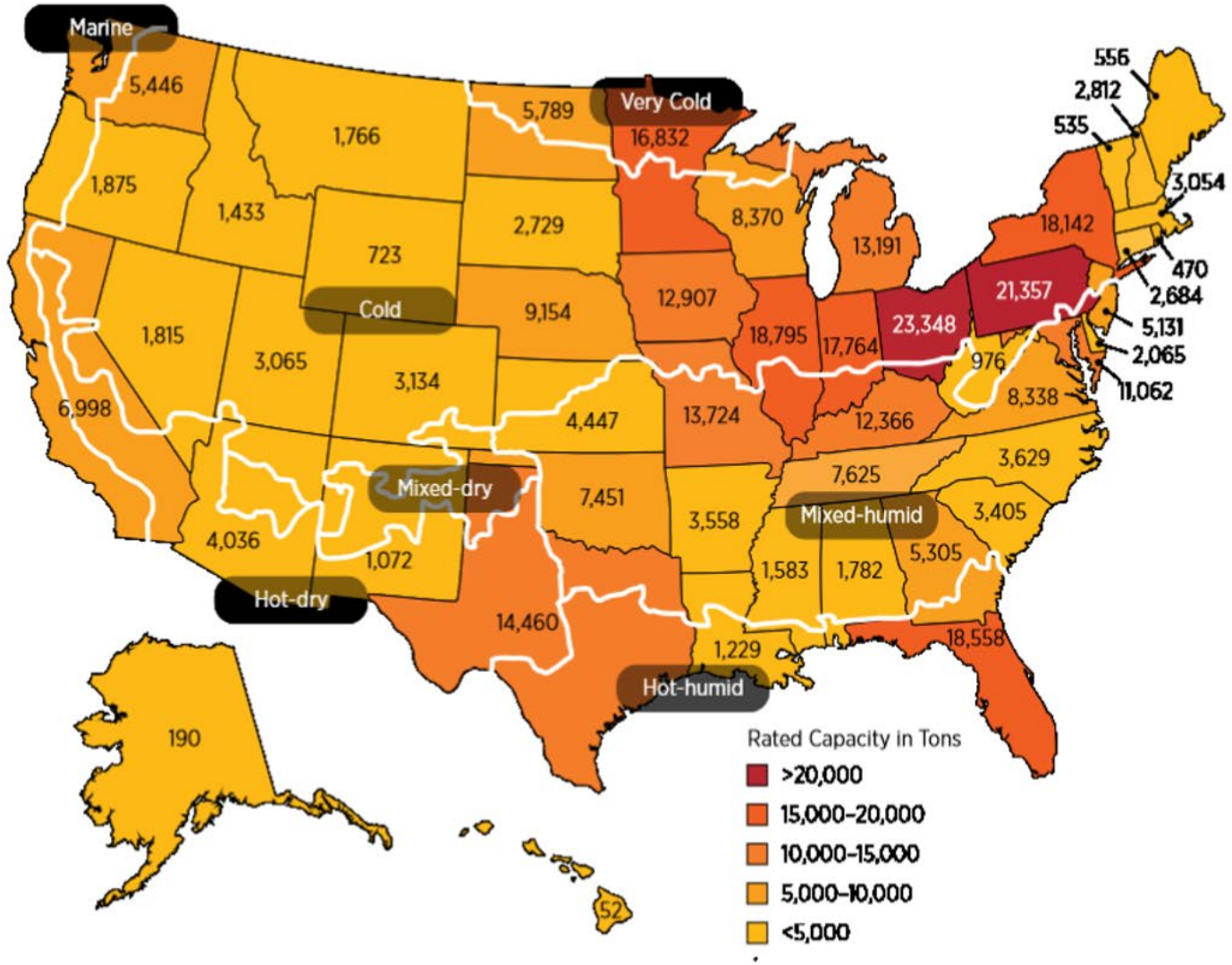
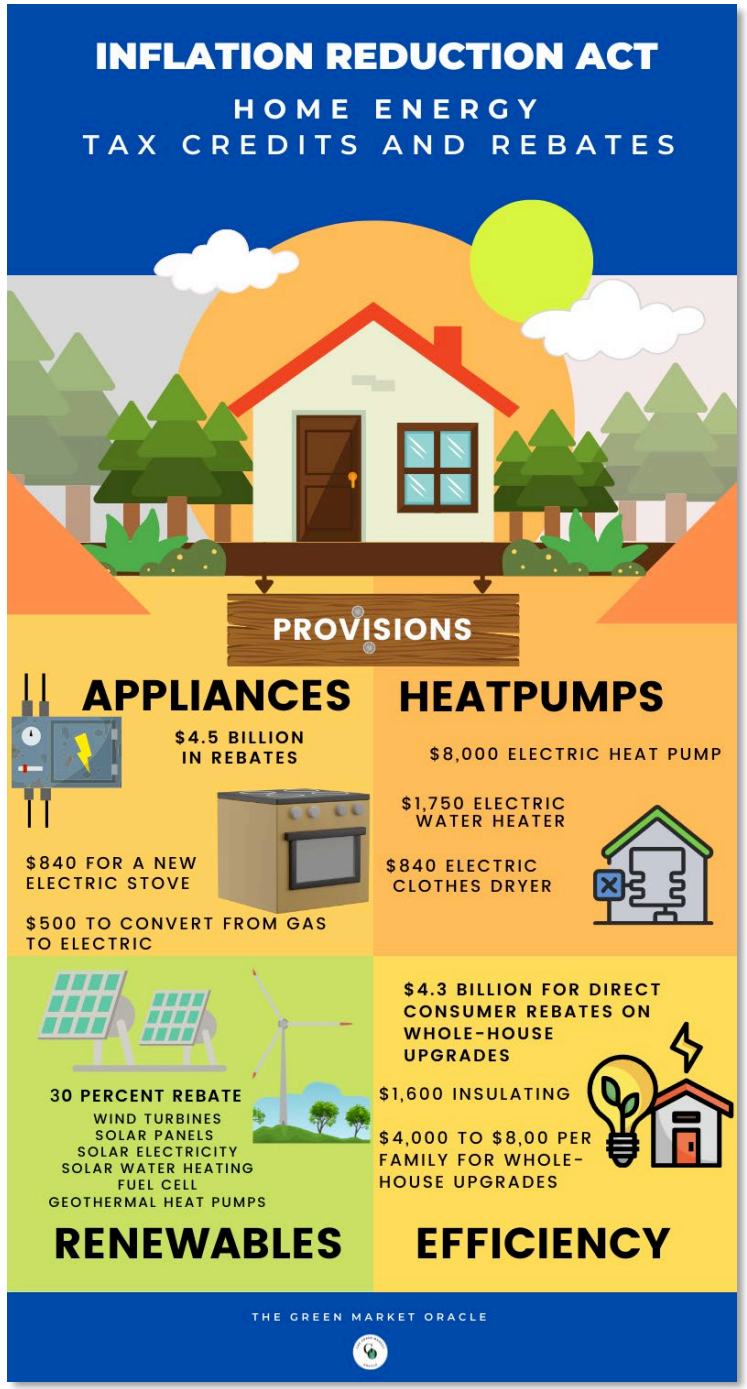


Figure 2-13. U.S. geothermal heat-pump shipments (rated capacity in cooling tons) in 2009

Source: Liu et al. 2018

Figure Note: The number in each state indicates the total capacity (cooling tons) of GHP shipments in 2009 in the state. The white lines indicate climate zones, which are based on the 2009 data on the destinations of GHP unit shipments in the United States and color-coded based on the total rated capacity (in cooling tons) shipped in that year (EIA 2010). The 2009 data are the last data available; EIA no longer tracks GHP shipments.



Provisions Affecting Geothermal Heat Pumps in the Proposed "Inflation Reduction Act"

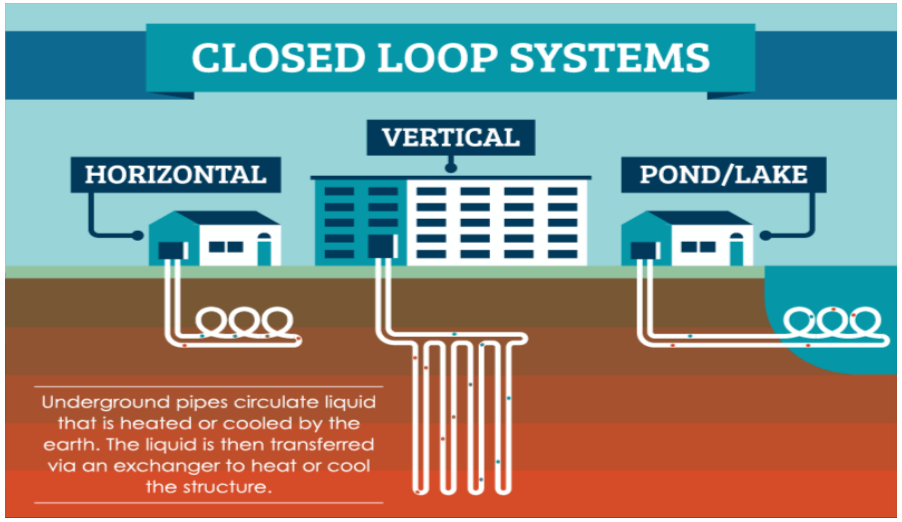
The Geothermal Exchange Organization (GEO) is the voice of the geothermal heat pump industry in the United States. Below is their summary of the provisions affecting geothermal heat pumps in the 'Inflation Reduction Act' and a brief outlook on where things will go from here. You can read the full text of the bill here.

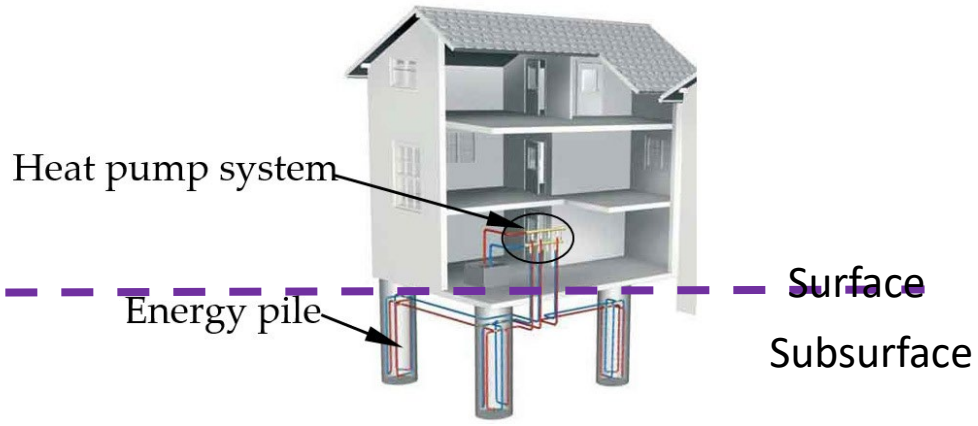
- **Section 25D residential tax credit** –
  - Under current law, the credit is at 26% in 2022, 22% in 2023, and expires at the end of 2023.
  - The bill extends the credit for all Section 25D technologies at the following rates:
    - 26% (2021)
    - 30% (2022-2032)
    - 26% (2033)
    - 22% (2034)
    - 0% (2035)
  - The House-passed version of the bill made the credit fully refundable, subject to extensive verification requirements on installers to guard against fraud. These refundability and verification requirements have been removed.
- **Section 48 commercial tax credit** –
  - Section 48 is extended under a two tier structure:
    - A "base rate" of 6% (or 1/5 of the bonus rate)
    - A "bonus rate" of 30%

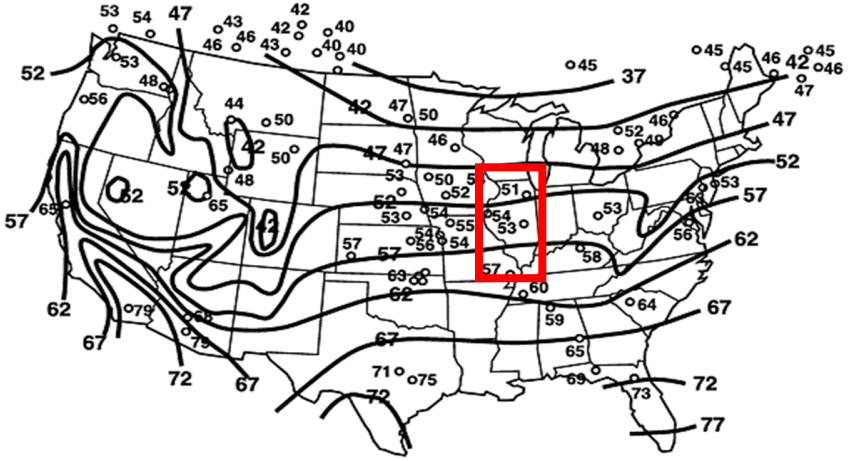
- The House-passed version of the bill provided for direct pay/refundability of the credit. In this version, direct pay/refundability is only available under Section 48 for the following entities:
  - tax-exempt organizations;
  - state or local government (or political subdivision thereof);
  - Tennessee Valley Authority;
  - Indian tribal government; and
  - Alaskan Native Corporations.

- The bill includes a domestic content bonus credit for facilities that use domestic steel, iron, and manufactured products. The bonus credit is two-tiered:
  - 10% (projects that either meet prevailing wage/apprenticeship requirements or are under 1MW of electrical or thermal energy)
  - 2% (projects over 1MW that don't meet prevailing wage/apprenticeship requirements)

Energy geostructures



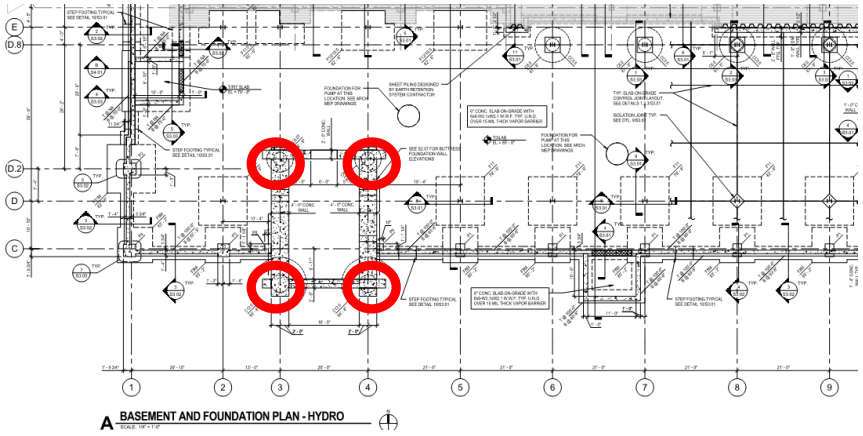


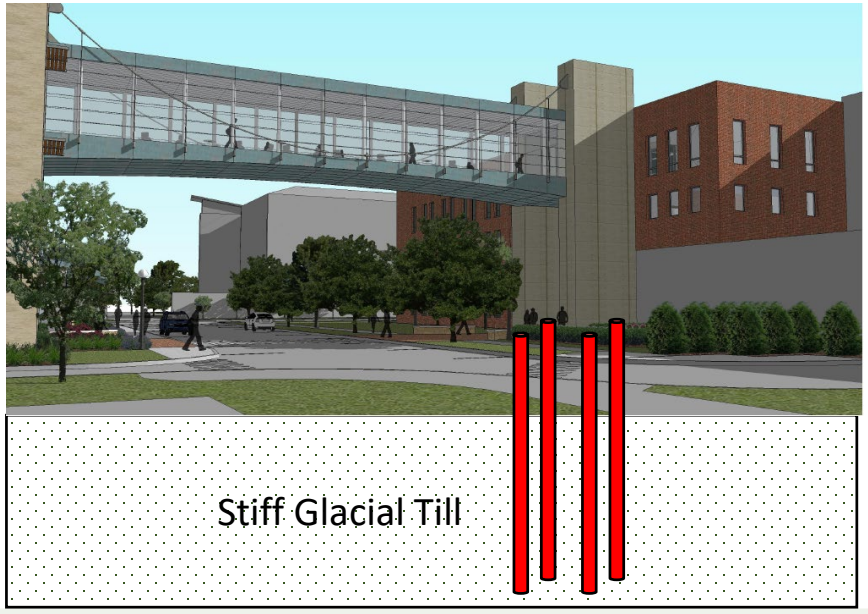


GeoReL

Energy Foundations: Installation

Instrumented energy foundations at the Ven Te Chow Hydrosystems Laboratory



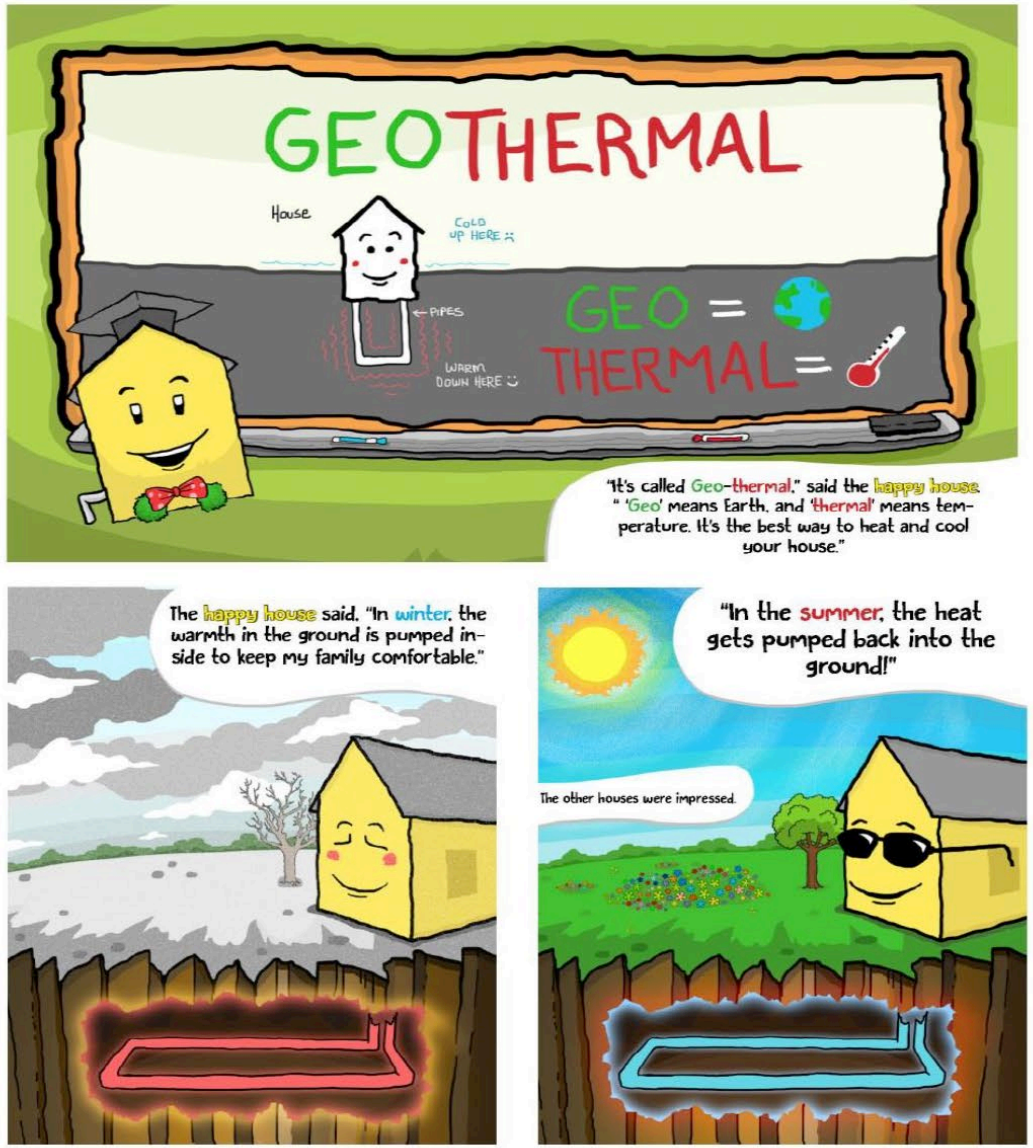


T. Baser (2020)

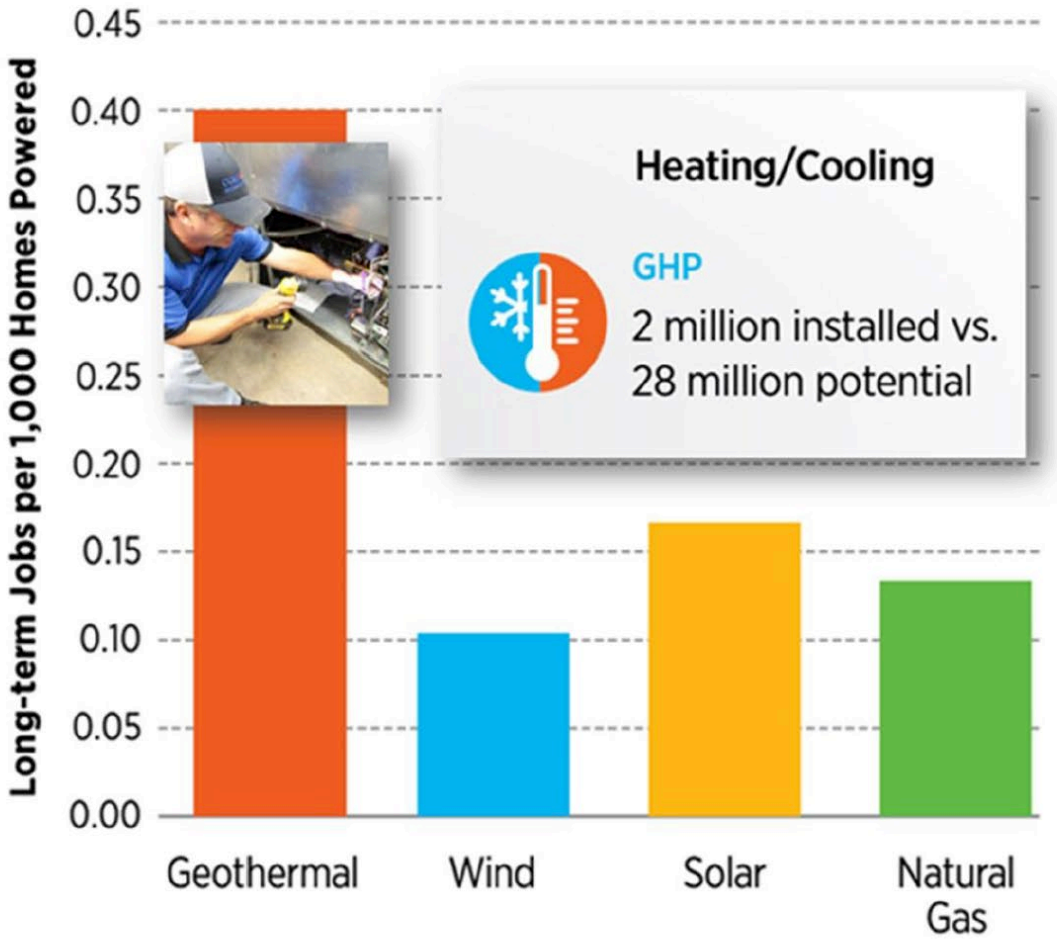
GeoReL

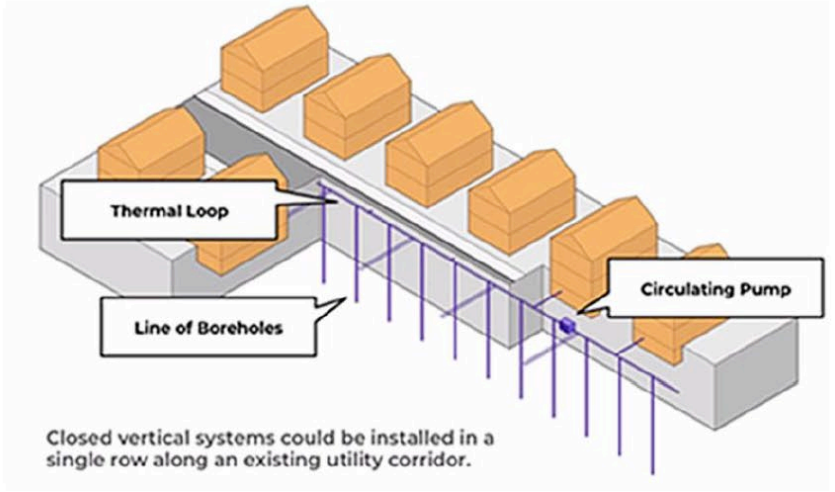
A New Way of Thinking About GEO

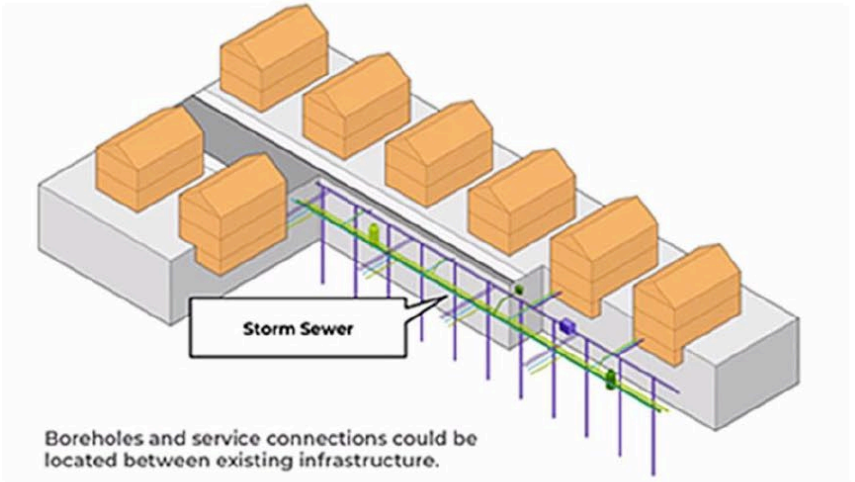
1. The Basics of Geothermal Systems
2. Beneficial Electrification through GHPs
3. Benefits of Reductions in Cooling Tower Use
4. Community Infrastructure Can Aid Geothermal as Utilities & Geothermal Grids
5. More Ways to Couple with Infrastructure
6. Aging Natural Gas Pipelines to >> Geo Districts
7. Health and Human Safety;
   a. Reduce/Eliminate Combustibles
   b. Reduce/ Eliminate Legionnaires Disease
8. Load Diversification / Thermal Advantage
9. Surface Water Exchange



This model will provide long lasting Clean Energy employment for thousands of workers







Thank you

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Tugce Baser: tbaser@illinois.edu