

# Geothermal Energy

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Period 1

**Question:** How many of you have been to Palm Springs or Yellowstone National Park?

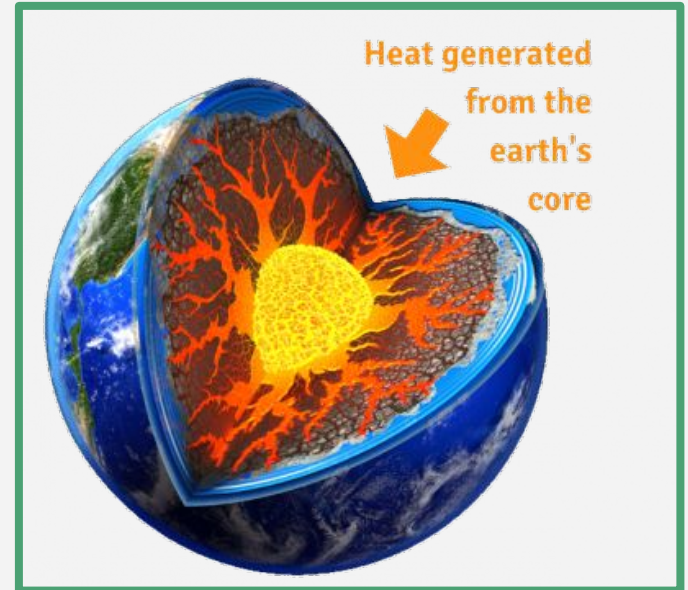
If you answered yes to any of the above questions, you have witnessed geothermal energy in action!



# So what is Geothermal Energy?

Definition: Energy derived from heat within the Earth

- Greek root “geo”- Earth
- Greek root “therm”- heat



# History of Geothermal Energy

10,000 years ago

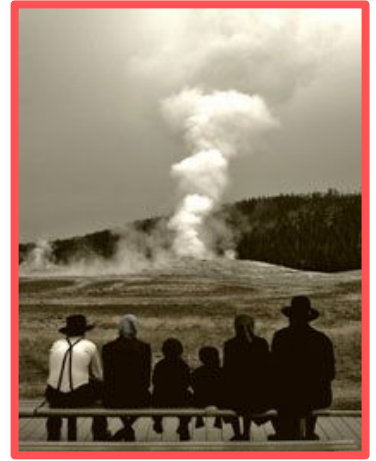
First human use of geothermal energy (hot springs)

1904

First geothermal power plant is created in Larderello, Italy

1970

The Geothermal Resources Council is formed



1807

European settler, John Colter, explores Yellowstone area and comes across hot springs

1960

First large-scale power plant in U.S. is established at The Geysers

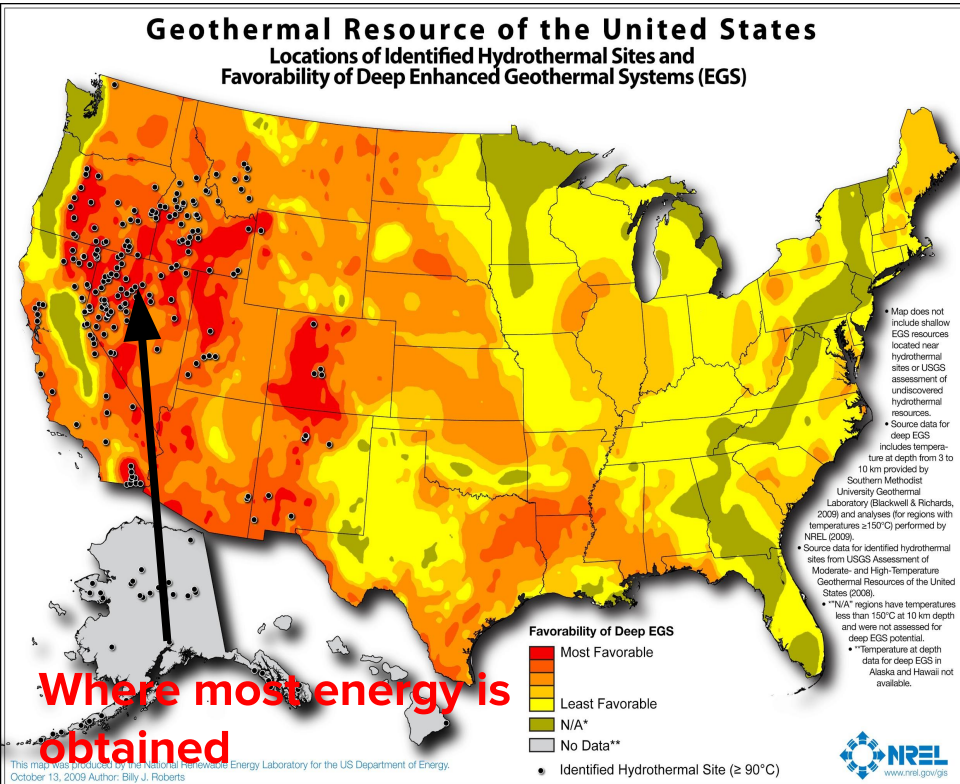
1972

Formation of the Geothermal Energy Association

# The Politics Behind Geothermal Energy

## How It Affects the U.S. and Foreign Relations:

- geothermal energy can be harnessed domestically → (don't have to rely on foreign nations)
  - ◆ ex. helps decrease tensions for oil in the Middle East
- reduces our reliance on international markets, and allows U.S. to be self-sufficient



# Geothermal Energy:

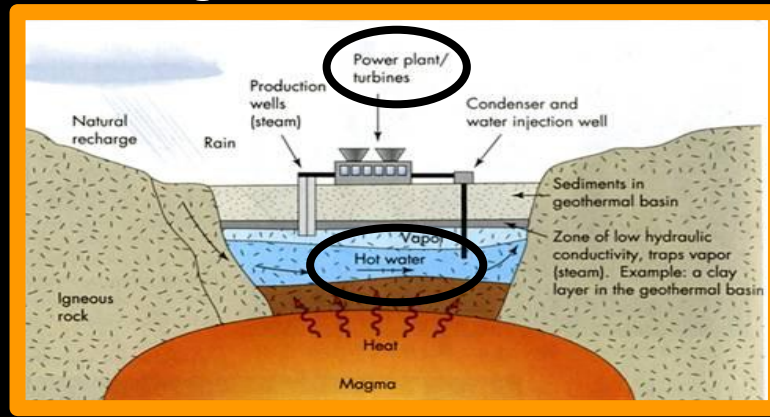
## Political Achievements and Breakthroughs



- **1970: Formation of Geothermal Resources Council** (encouraged geothermal research worldwide)
- **1970: Geothermal Steam Act** (designating lands for geothermal exploration and use)
- **1972: Geothermal Energy Association** (helps grow geothermal energy worldwide)
- **2005: Energy Policy Act** (made geothermal energy more competitive with fossil fuels)

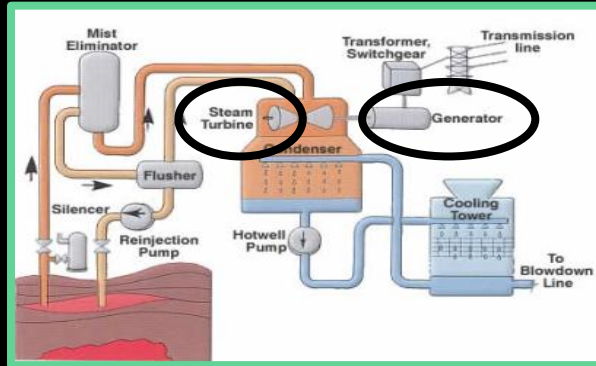
# Essential Vocabulary!

- **geothermal fluid:** hot water found deep below Earth that can either be in the form of geysers, hot springs, or rocks
- **geothermal reservoir:** a region below the surface with rocks that contain hot water and steam
- **production well:** produces geothermal fluid that is heated naturally from Earth



# Essential Vocabulary (continued)...

- **injection well:** returns used fluids back to Earth
- **turbine:** a steam-powered machine that rotates to create electrical energy
- **generator:** converts kinetic energy into electric energy
- **rotational energy:** the kinetic energy of a rotating object





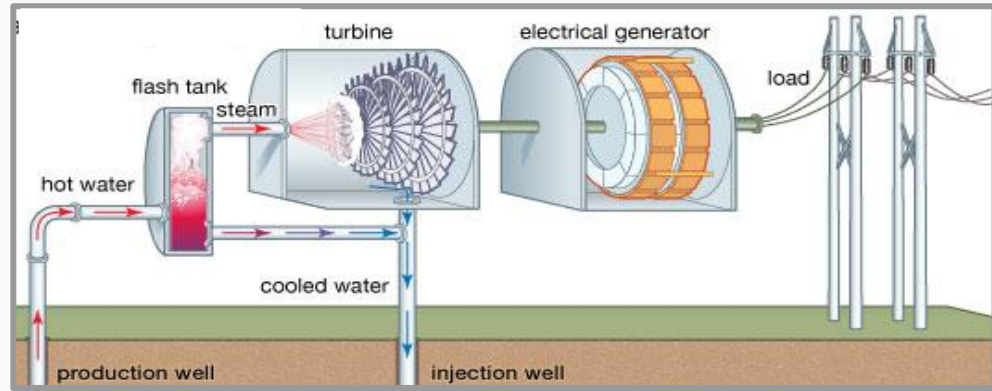
# How a Geothermal Plant Works:

## Step 1: Well

- A production well and injection well is drilled into a geothermal reservoir
- Hot fluids from Earth travels through pipes

## Step 2: Turbine

- Pipes and hot water reach turbine
- The geothermal fluid is then turned into steam, which allows the turbine to turn (rotational energy)



## Step 3: Generator

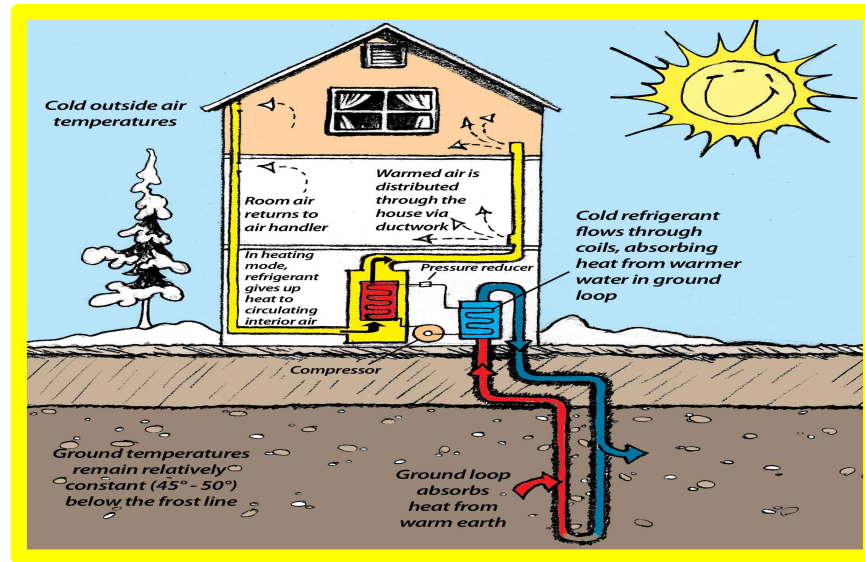
- Magnets inside generator spin due to the rotational energy produced by turbine
- Energy transfers from geothermal to electrical

## Step 4: Transmission

- The electrical current produced by the generator is sent to a transformer
- The electrical current is then transmitted through power lines

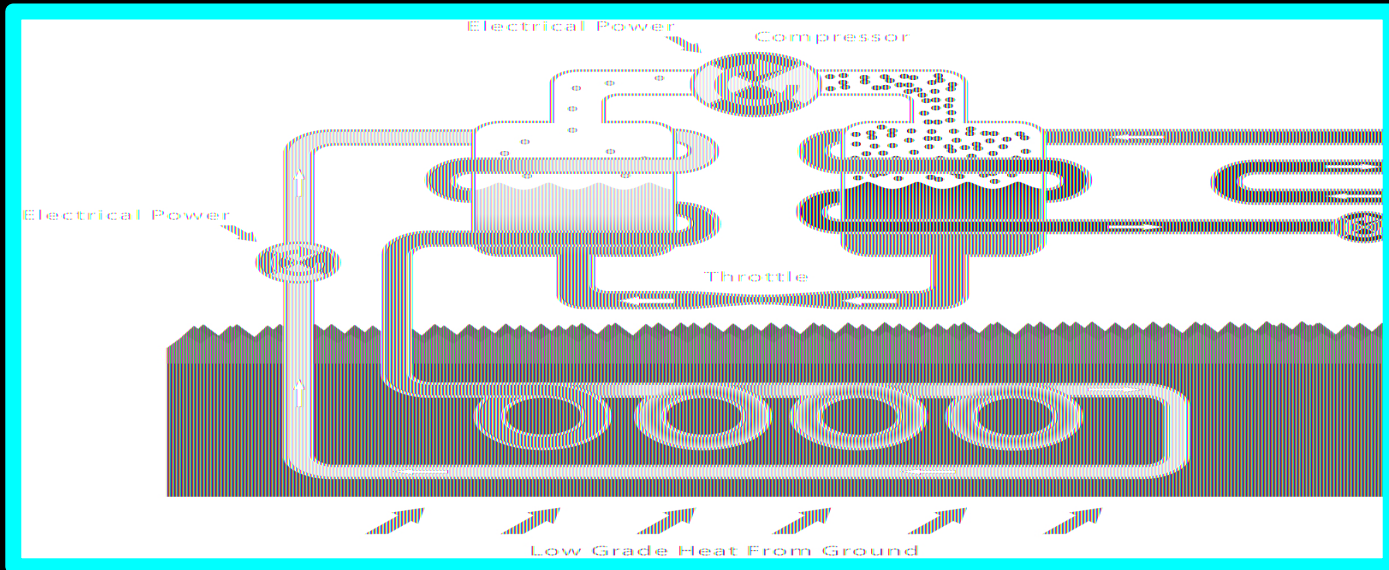
# How a Geothermal Heat Pump Works:

- Approximately 2-3 feet below the ground, there is water that remains at a constant 50-60°F (10-15°C) all year round.
- This water can circulate through pipes beneath the ground.



# How a Geothermal Heat Pump Works (continued)...

- An electric compressor and heat exchanger extract the heat from the pipes, and carry it to the heating systems within homes and buildings



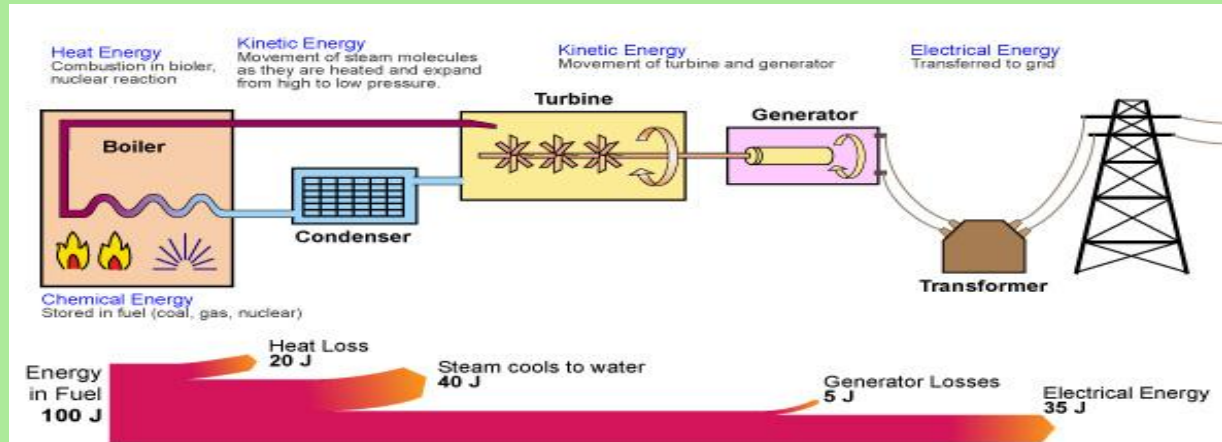
# The Physics of Geothermal Energy



A geothermal power plant utilizes physics in order to operate due to the **transfer of energy** from one form to another!

→ first, there's **thermal energy** from the hot fluids within Earth

→ the steam produced by this thermal energy allows the turbine to turn, producing **rotational energy** (kinetic energy)



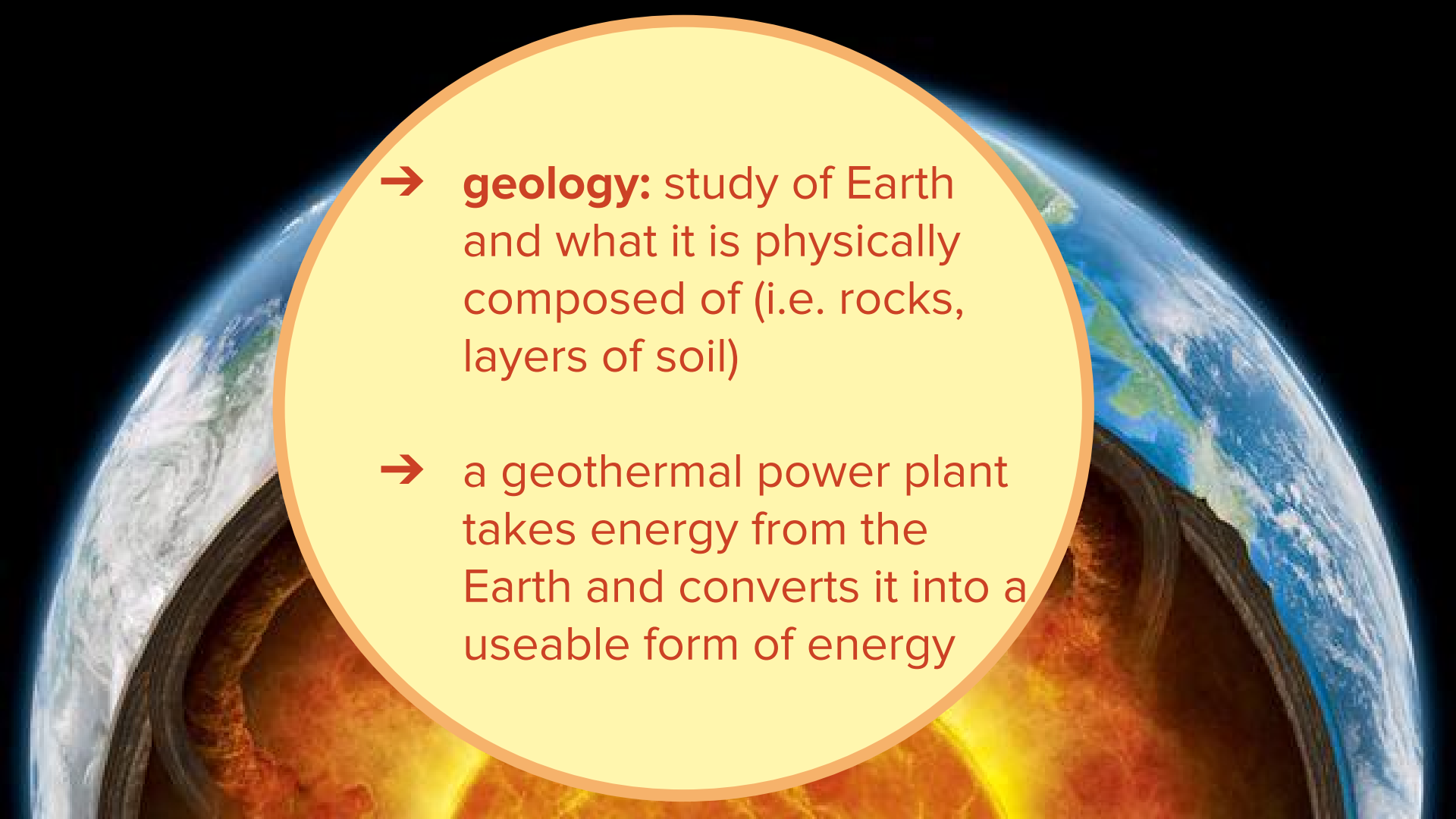
- the rotational energy enables the magnets within the generator to spin, creating an electrical current
- a transformer then turns it into **electrical energy** that travels through power lines
- now, the once thermal energy is in a form that can help power homes, businesses, schools, and even this slideshow!





# The Geology of Geothermal Energy

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- **geology:** study of Earth and what it is physically composed of (i.e. rocks, layers of soil)
  - a geothermal power plant takes energy from the Earth and converts it into a useable form of energy



# Why Use It?



## Cost efficient

- Costs 20% of fossil fuel prices
- Low production & transportation cost



## Reduces reliance on fossil fuels

- Prices of fossil fuels are increasing while resources decrease



## No pollution

- Helps reduce global warming
- Helps create a cleaner environment



## Creates jobs

- More production plants = more jobs

# Production and Use of Geothermal Energy

## Southern California

- #1 producer in U.S.
- 4.5% of all energy in state

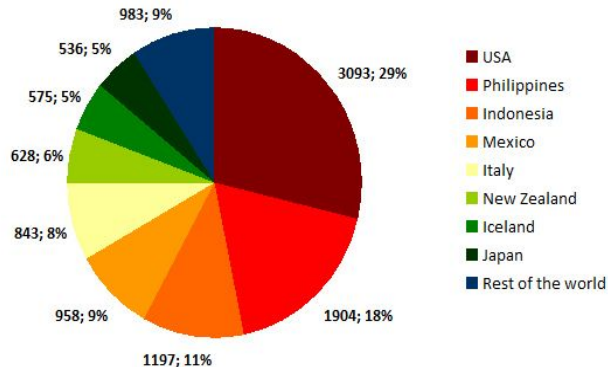
## National

- more than 40 geothermal plants across America
- produces about 1% of nation's electricity
- power plants located in California, Nevada, and Oregon (the West)

## Global

- approx. 10% of world's energy use
- U.S.
- Iceland
  - main source
- Japan
- New Zealand
- Mexico
- Philippines
- Indonesia

GEOTHERMAL: INSTALLED GENERATING CAPACITY IN 2010  
(data in Mwe and in percentage)



## Additional Questions:

### 1.) How does the use of your energy source affect the environment's climate?

→ causes NO pollution!



→ reduces the need for fossil fuels, which contribute to global warming, acid rain, and water & air pollution



→ helps create a cleaner environment overall

◆ allows us to be less dependent on coal, oil, and natural gas

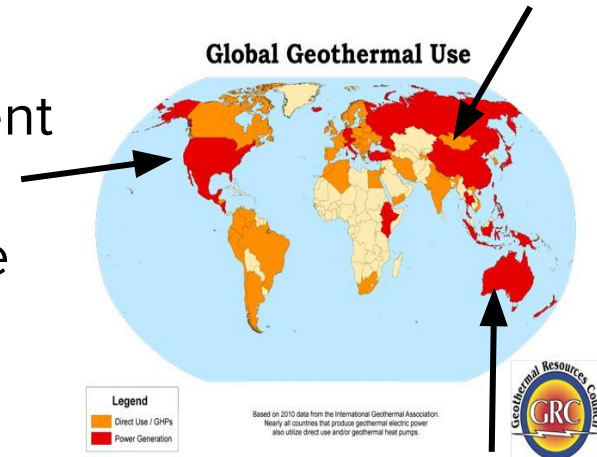


# Additional Questions (continued)...

## **2.) What are the shortcomings of your source? Possible solutions? Is it easy or difficult to achieve?**

### Shortcomings:

- not that popular of an energy source, therefore installation is difficult and costly
  - ◆ requires skilled staff, time, and investment
- only suitable for specific locations
  - ◆ must have hot rocks underneath surface



## Additional Questions (continued)...



### Solutions and Plausibility:

- in the long run, geothermal energy pays off, thus cushioning the initial investment
  - ◆ in general, not a widely used energy source, so would the investment be worth it in the long run?
- partnering (research wise and financially) with other countries that have the ability to harness this type of energy
  - ◆ definitely a possibility, but since location is key, costs might outweigh benefits

Thanks For Watching!

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