Geothermal Energy

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History

Direct Uses

- Medical Uses
- Bathing
- Cooking
- Floor Heating
- Electric Generation

Medical Uses

Bathing

Huaqing Pool,

China

Geothermal Cooking

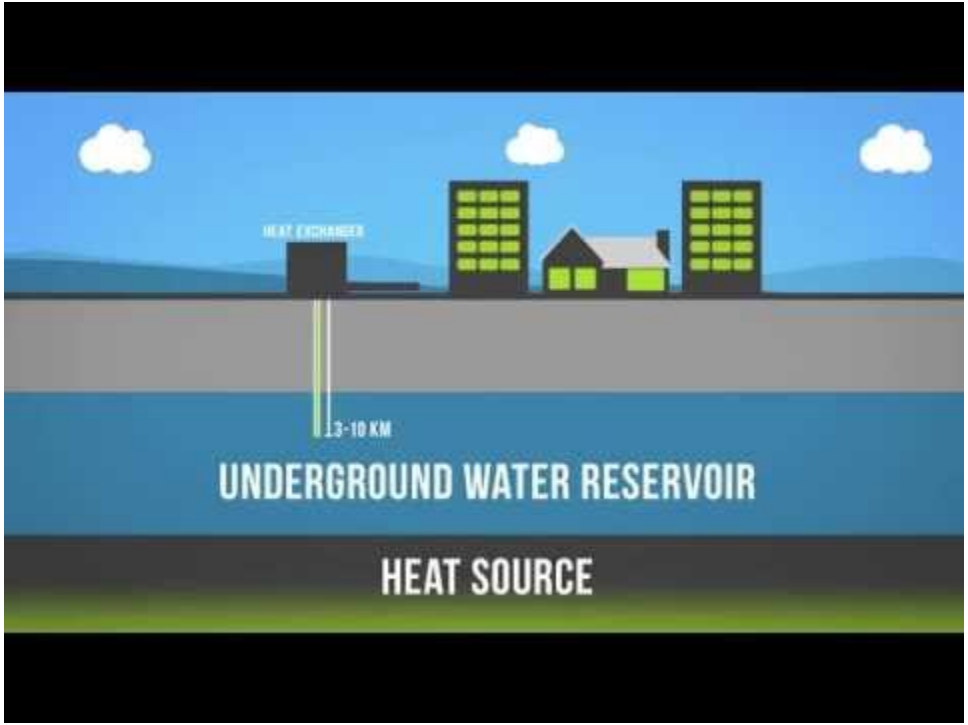
The most ancient use of Geothermal Energy

A volcano-cooked meal?

Geothermal Heating

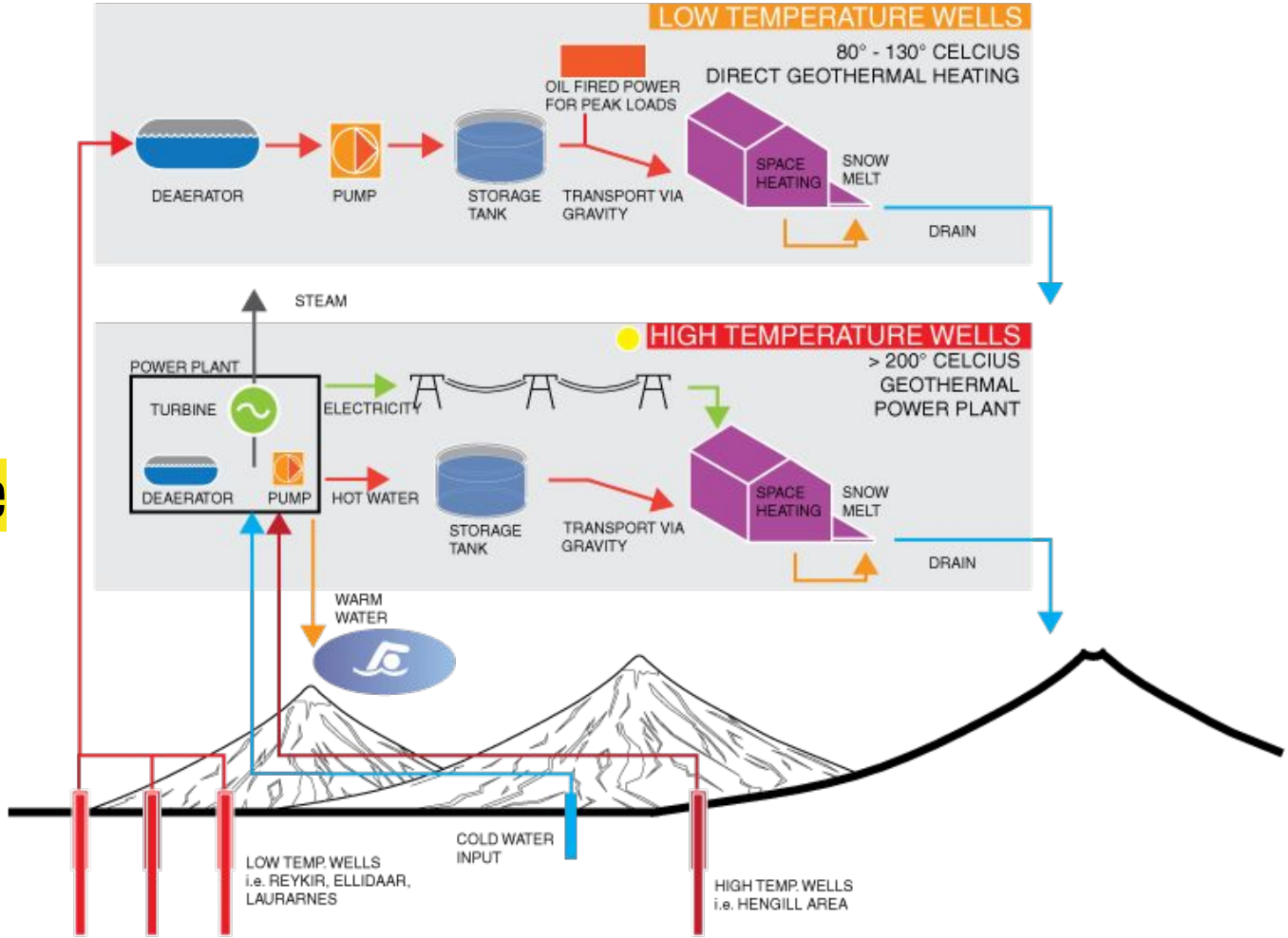
How does it work?

The Basics

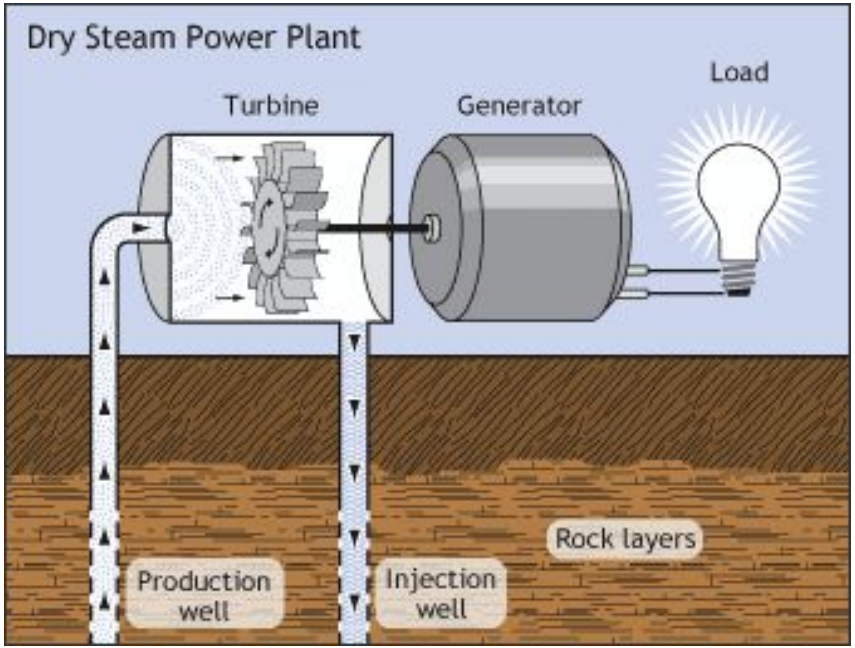

HEAT EXCHANGER
3-10 KM
UNDERGROUND WATER RESERVOIR
HEAT SOURCE

Types of Geothermal Plants:

The General Principle



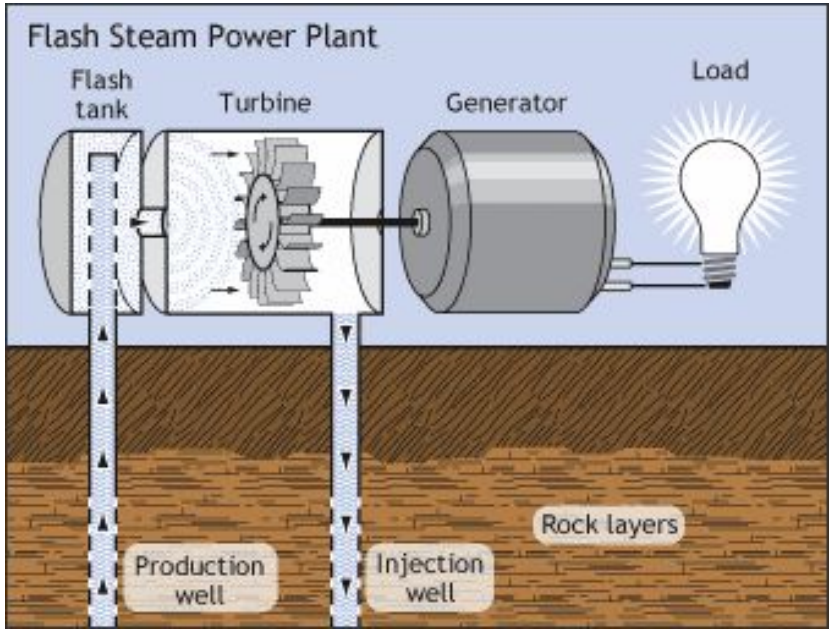
Dry Steam



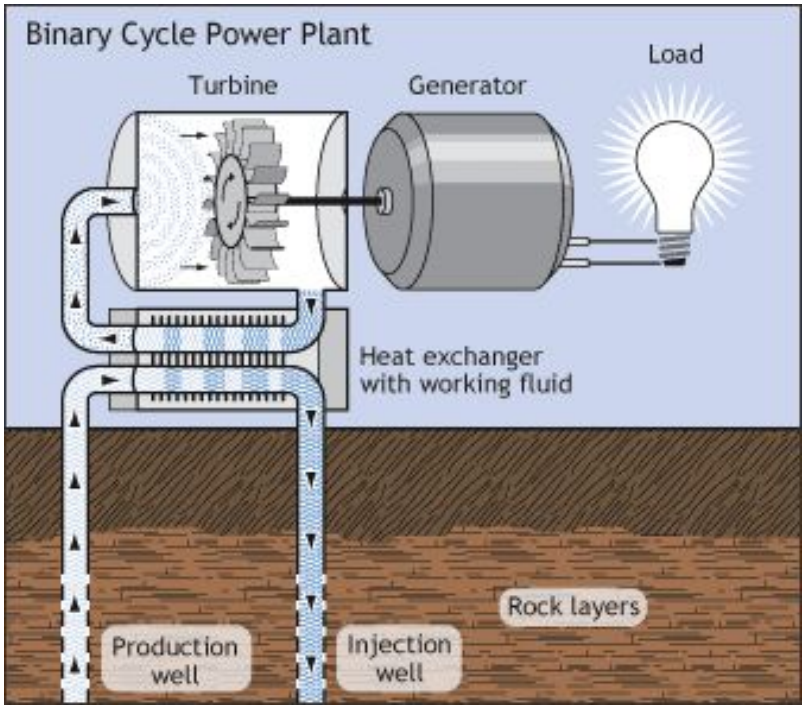
- First type of Geothermal powerplant ever made
- First used in Lardarello, Italy in 1904
- Currently used at The Geysers in California

Flash Steam

- Most commonly used type of Geothermal Power Plant
- “Flash”



Binary Cycle



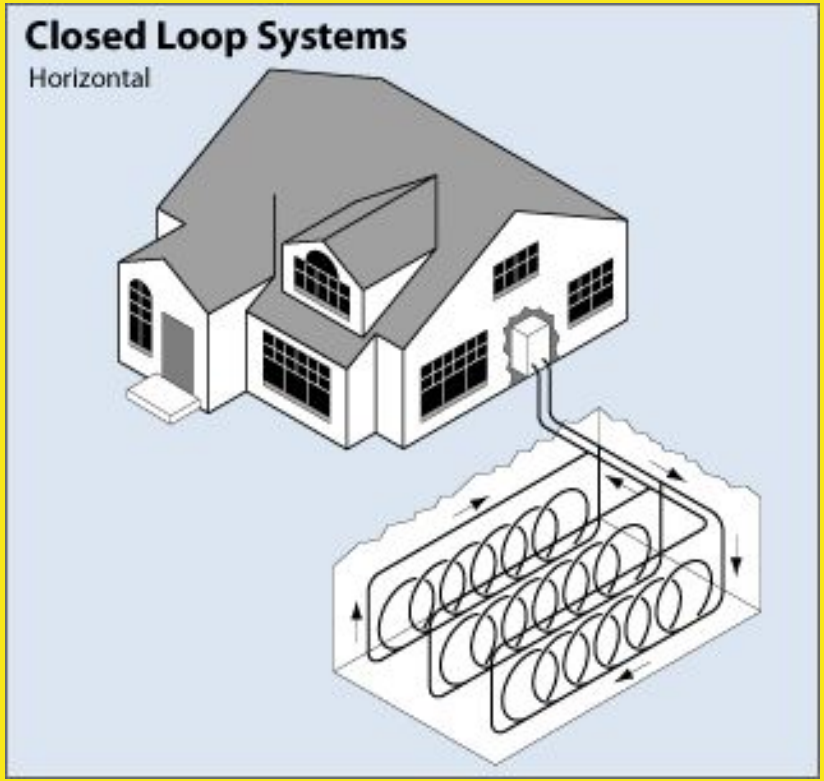
- Closed Loop System
- “Binary”
- NOTHING emitted into atmosphere
- The Future of Geothermal Energy

Geothermal Loop Fields

Closed-Loop

Horizontal

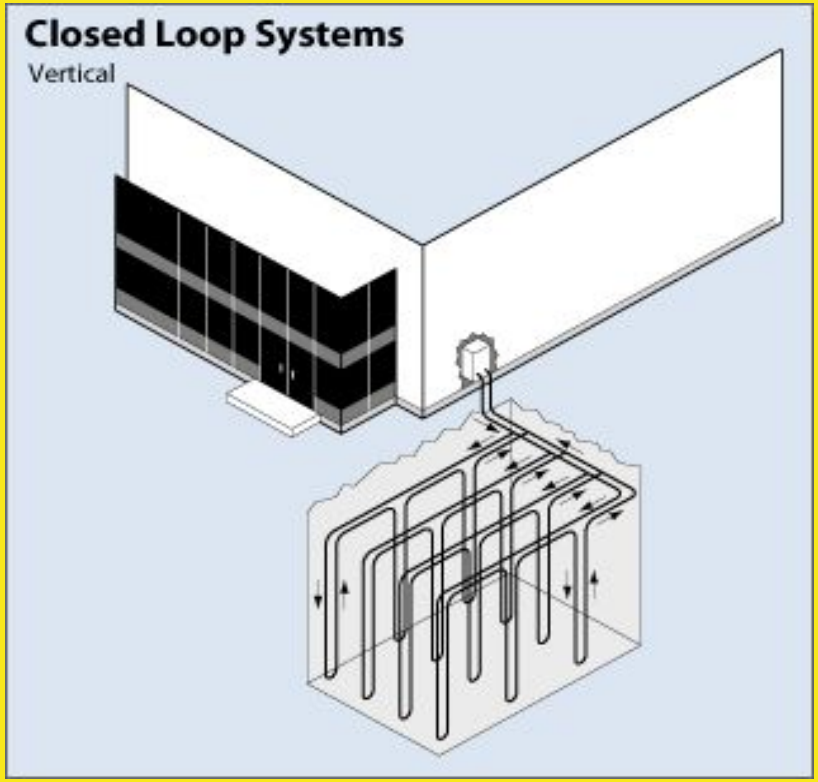
- Cost effective for residential
- Space is needed
- Trenches need to be at least 4 ft. deep



Closed-Loop

Vertical

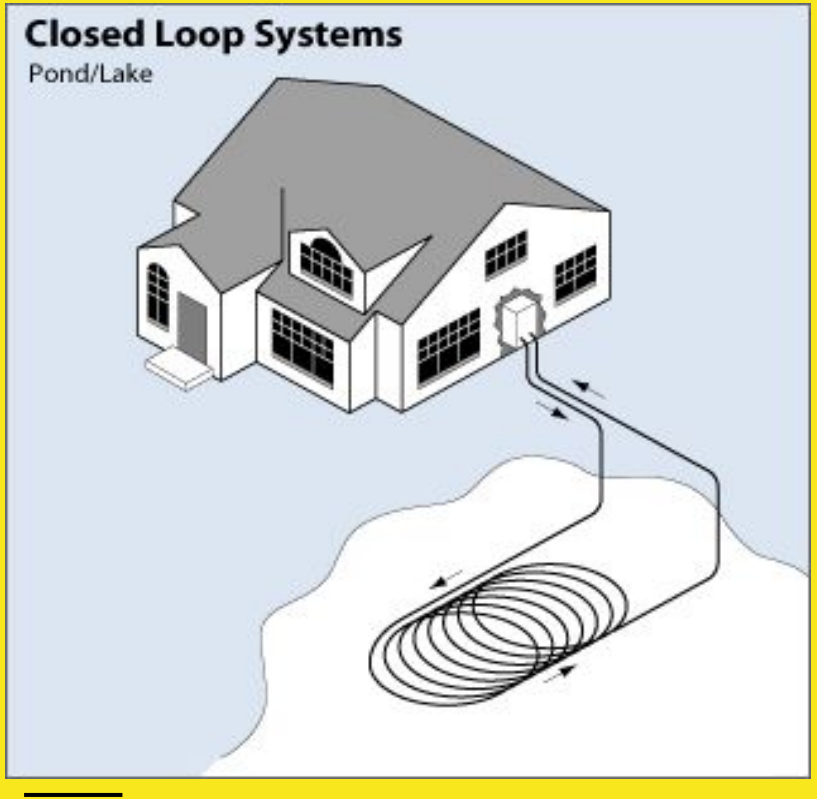
- More common for commercial installations
- Used where soil is shallow
- Minimize disturbance to existing landscape



Closed-Loop

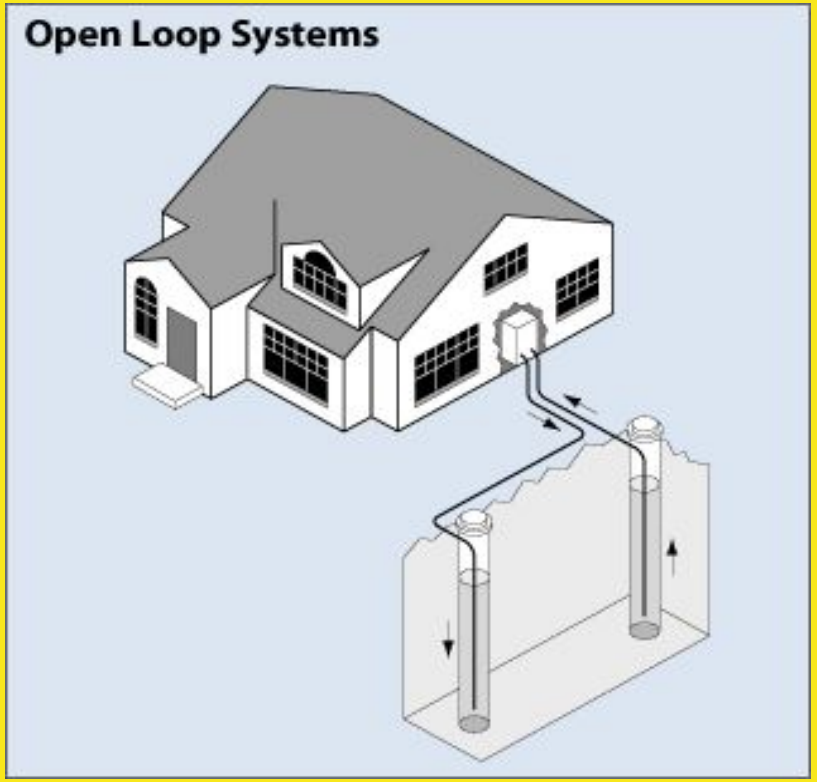
Ponds or Lakes

- Medium body of water accessible
- Low-cost option



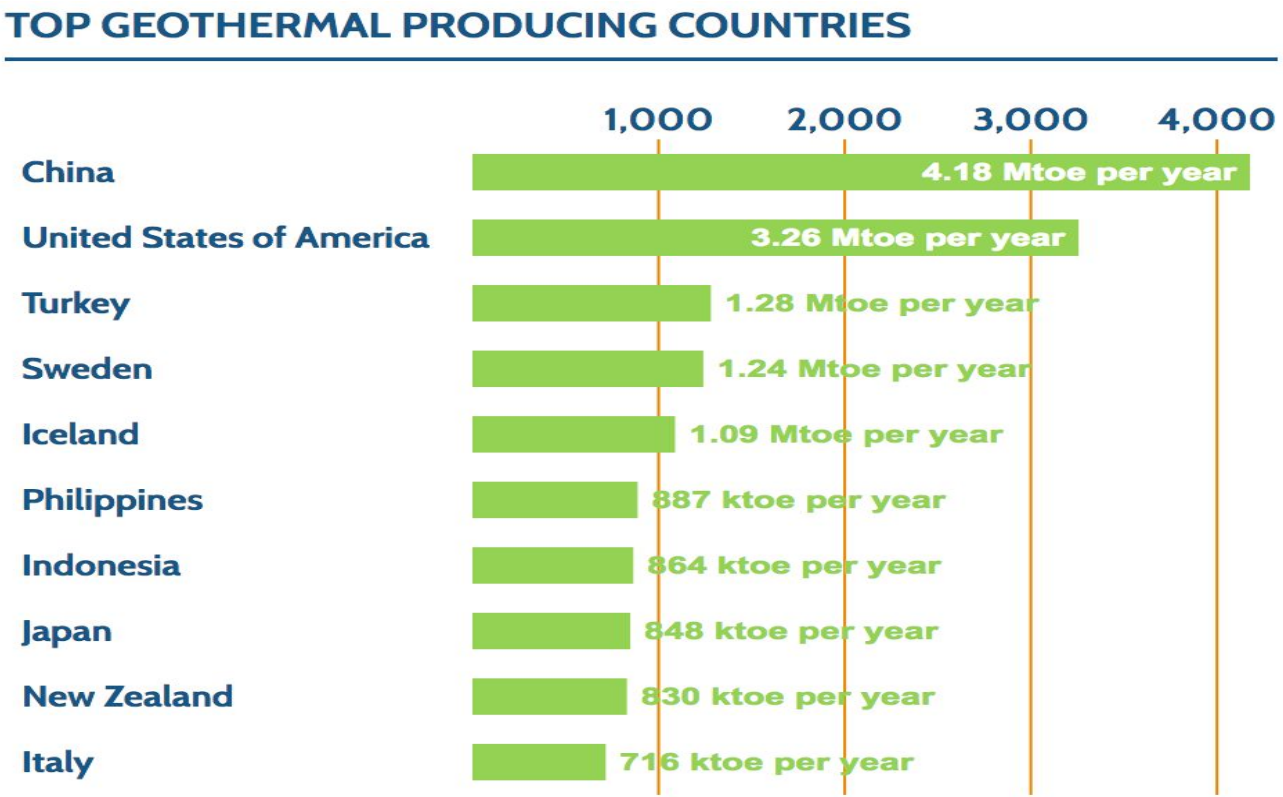
Open Loop

- Uses well or surface body of water as heat exchange fluid

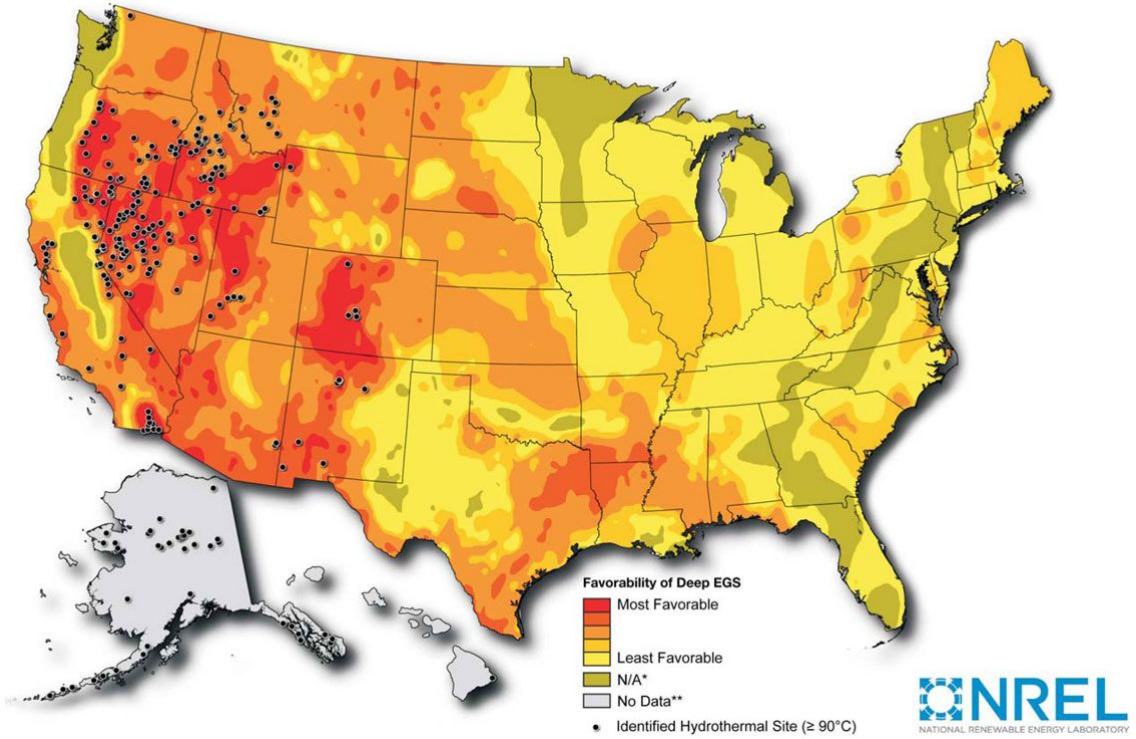


Some Stats:

Top Geothermal Producing Countries



Geothermal Resources USA



Pros and Cons of Geothermal Energy

Pros:

- Environmentally friendly and does not cause significant amount of pollution
- It is not possible to exhaust the resources
- Meets the base load energy demand unlike wind and solar
- Great for heating and cooling
  - Even small households
- Requires minimal land, large portion can be constructed underground
- Costs have recently lowered due to technological advances

Cons:

- More suitable to implement in new homes
  - Retrofitting involves large scale excavation
- Damage to underground loops can be difficult and costly to repair
- Fewer installers therefore less competition
- Installation location specific
- Upfront costs are high

Costs

- Geothermal systems require design of a contracting engineering firm
- Cost is dependent on type of loop system
  - Land availability
- Installation requires expertise
- Average cost is between $20,000 and $25,000
- Payback for a system ranges between 2-10 years
- Lifetime of a system is 18-23 years
- There are US tax rebates for energy efficiency improvements including a 30% federal tax credit
  - State and utility companies offer incentives

Example:

Total Project Cost: $15,000

Down payment / Rebate: 0

Amount Financed: $15,000

Interest Rate: 8.99%

Term: 180 months

Payment: $142.50

Environmental Problems

Nothing is perfect

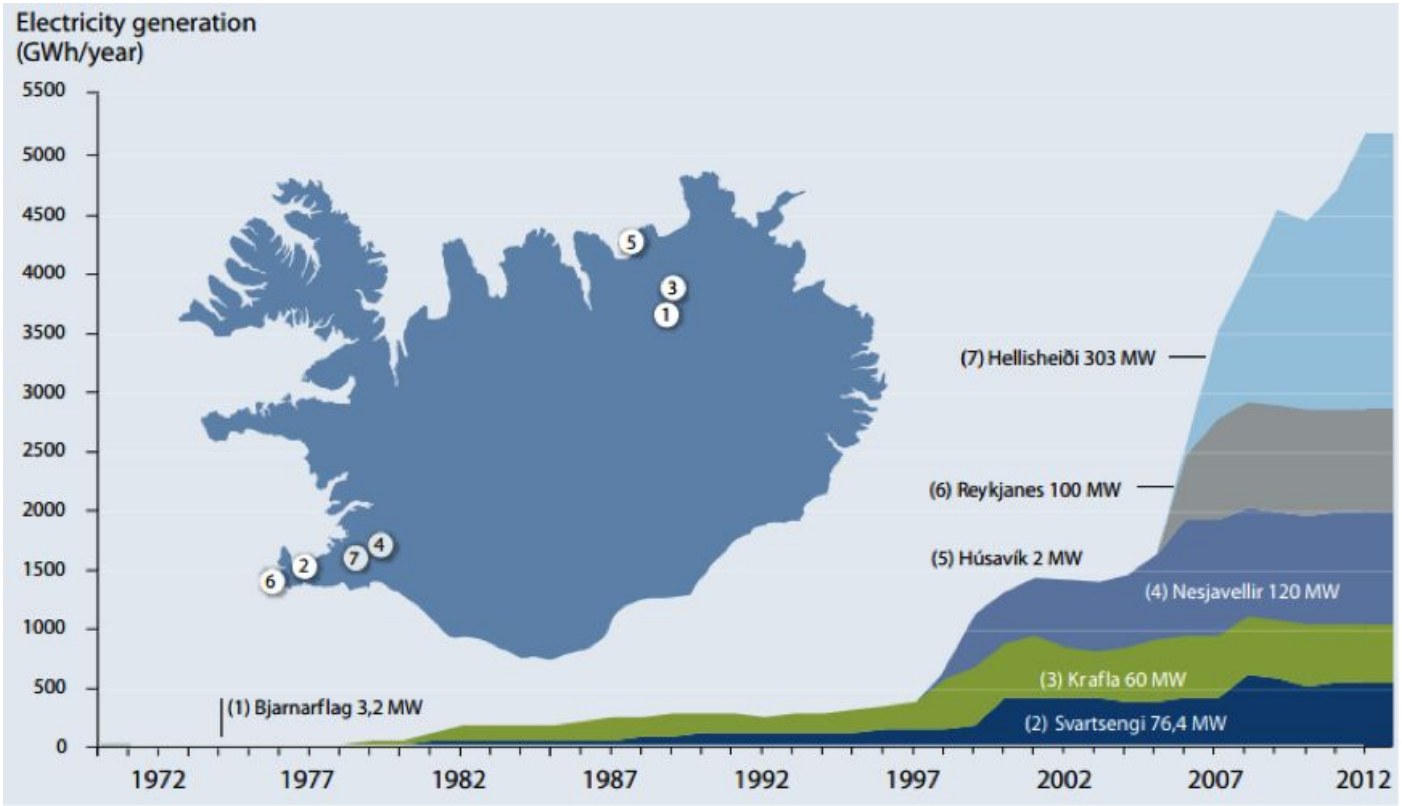
- Release of hyrdogen sulfide
- Disposal of geothermal fluids
- Some locations may cool down

Let’s talk about Iceland

Facts:

- Renewable energy 85% of electricity consumption
- Energy independent by 2050
- 2010's "Greenest Country" - Guinness World Record
- First pipeline for heating Reykjavik in 1930

Geothermal Power Plants in Iceland

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The Future

How can the use of geothermal energy grow?

An MIT analysis in 2006 estimated that by mid 21st century, it is possible to supply 10% of US electric generation capacity from geothermal plants.

The End

Any Questions?