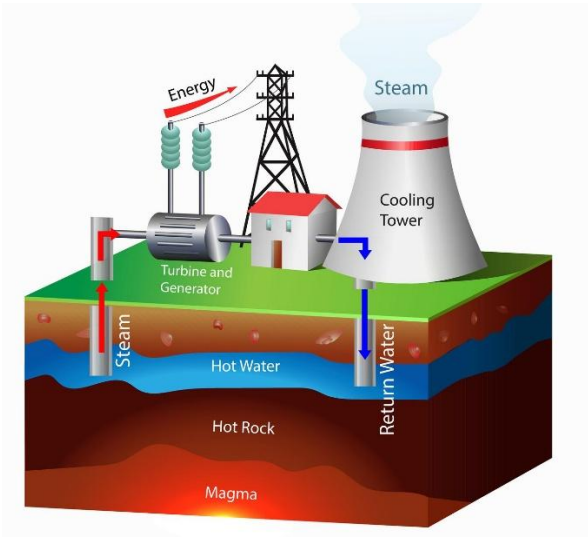
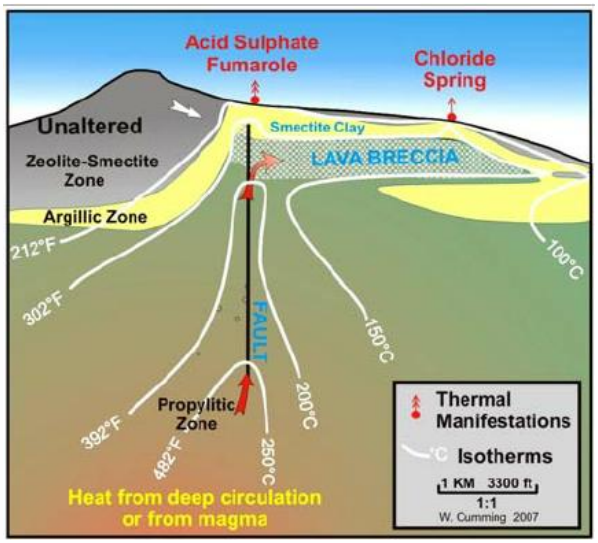
Section Four: Geothermal Energy

What is Geothermal Energy?

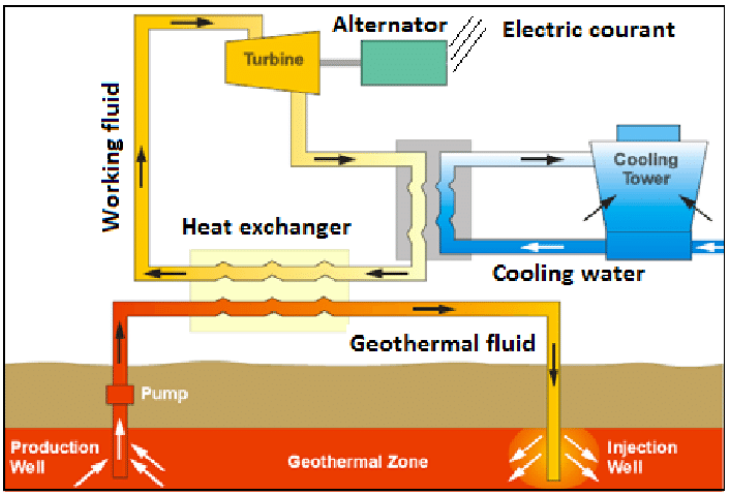
Geothermal energy is heat from inside the Earth used for electricity or heating.
It comes from radioactive decay, magma movement, and leftover planetary heat.
👉 Unlike solar or wind, geothermal energy works **24/7** because Earth continuously produces heat.

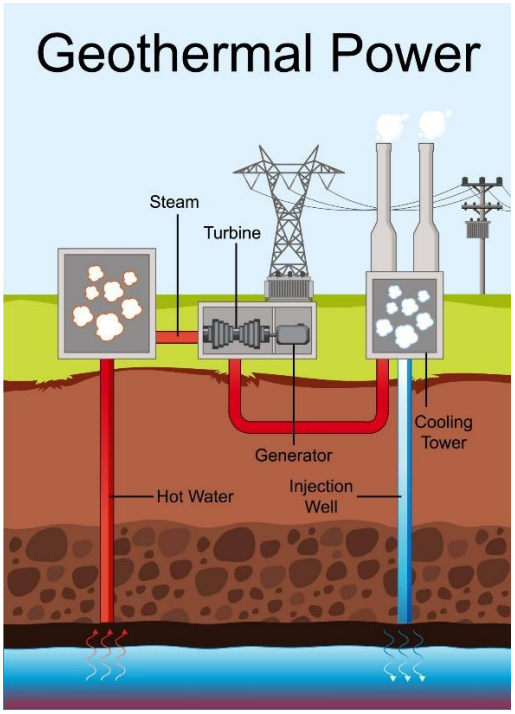




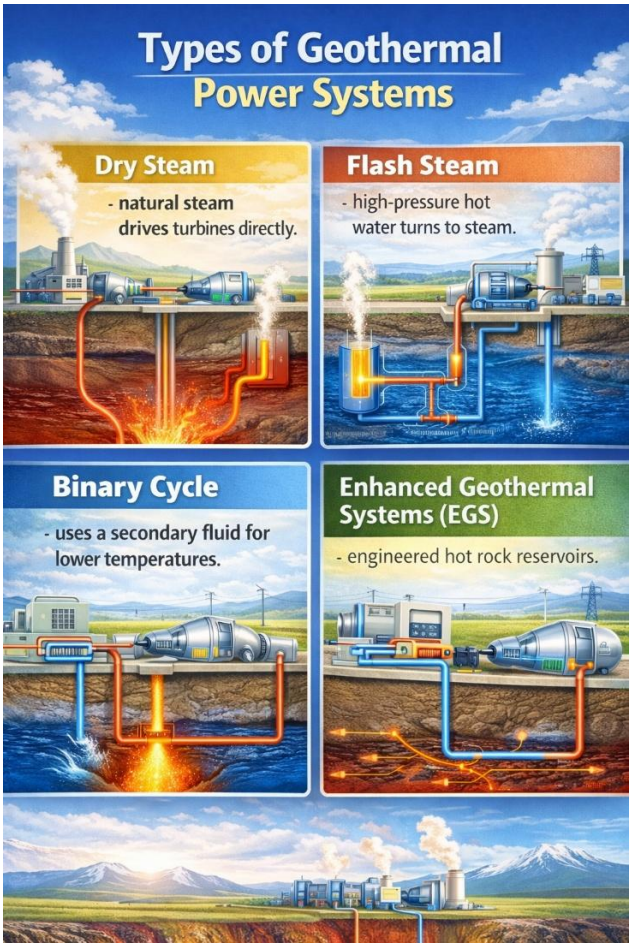
How Geothermal Energy Works

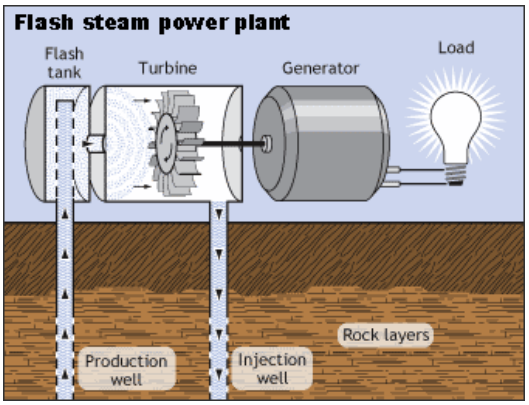
1. Deep wells reach hot underground reservoirs.
2. Steam or hot water rises to the surface.
3. Turbines spin to generate electricity.
4. Water is reinjected underground to maintain pressure.



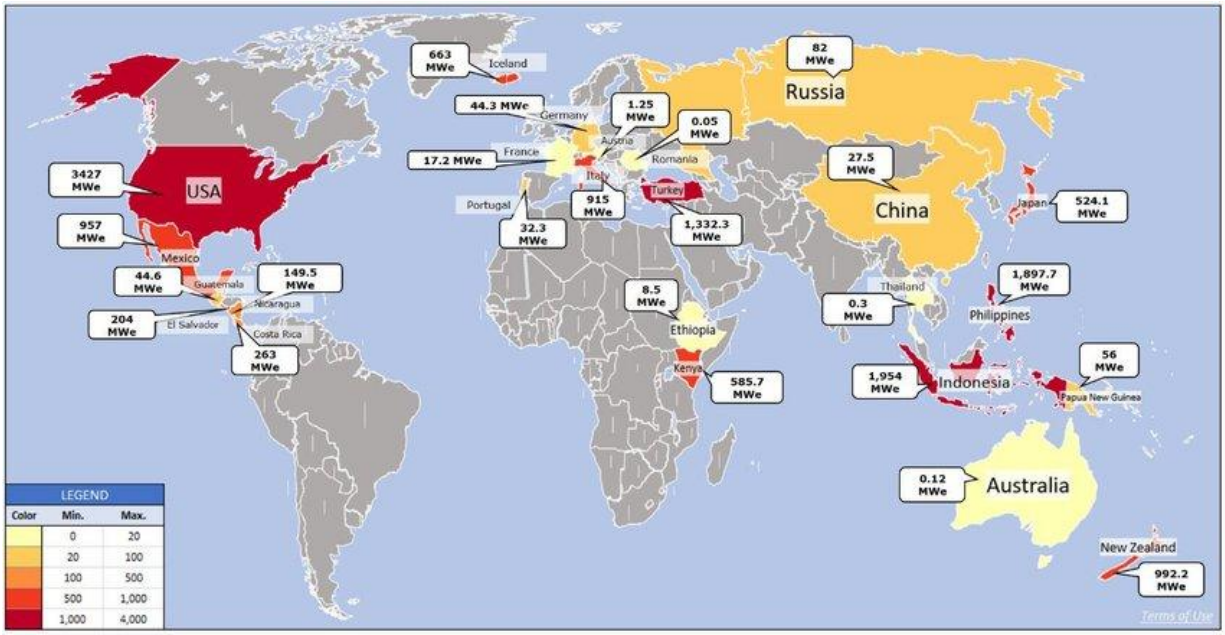


Types of Geothermal Power Systems





🌎 Where Geothermal Facilities Are Used



The unit **MWe** stands for Megawatts electrical. It is a unit used to describe the amount of electrical power a geothermal power plant can produce.

Geothermal facilities are not evenly spread across the world. Most are located near tectonic plate boundaries and volcanic regions because heat is closer to the surface there.

🌎 Major regions using geothermal power

- United States — largest installed capacity globally.

- Indonesia and Philippines — located on the Pacific “Ring of Fire”.
- Kenya — Rift Valley geothermal fields.
- Iceland — extensive geothermal heating and electricity.
- Turkey, New Zealand, Italy, Mexico, Japan — major producers.

Only about 28 countries currently generate electricity from geothermal energy, showing how location-dependent it is.

🔥 Why these places?

- Plate boundaries and volcanoes bring hot rock closer to the surface.
- Regions like the Pacific “Ring of Fire” have abundant geothermal resources.

👉 Example: In Iceland, geothermal heat supplies heating to almost 90% of homes due to volcanic activity.

The UK has limited geothermal electricity because it is far from active plate boundaries. However:

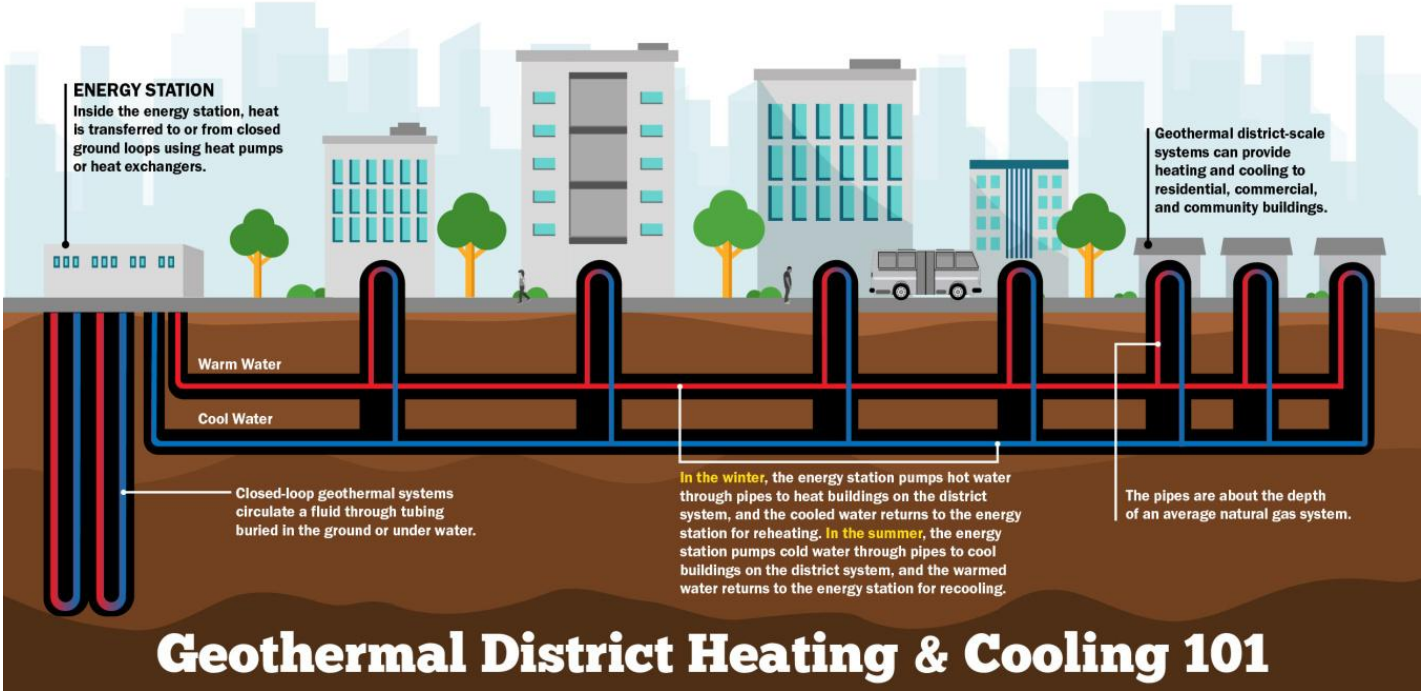
- Ground source heat pumps are common because shallow ground temperatures are stable.
- Some deep geothermal heating projects exist (e.g., district heating schemes).

👉 This is why places like Bristol or most of the UK use heat pumps more than geothermal power plants

Feature	Geothermal Facility	Heat Pump
Location	Volcanic/tectonic regions	Almost anywhere
Depth	Deep reservoirs	Shallow loops
Output	Electricity or district heat	Building heating/cooling
UK Usage	Rare	Common

🌍 Applications of Geothermal Energy

- Electricity generation
- District heating networks
- Building heating & cooling
- Agriculture and aquaculture
- Tourism (hot springs)



✅ Advantages and Challenges

Advantages:

✓ Reliable baseload renewable energy
✓ Low emissions
✓ Small land footprint

Challenges:

⚠ Only viable in certain geological locations
⚠ High drilling costs
⚠ Possible seismic risks in engineered systems

Summary

- Geothermal energy = heat from Earth's interior.
- Power plants are mostly in volcanic or tectonic regions (USA, Iceland, Indonesia, Kenya, etc.).
- Heat pumps work almost anywhere and are common in the UK.
- Main systems: Dry Steam, Flash Steam, Binary Cycle, EGS.