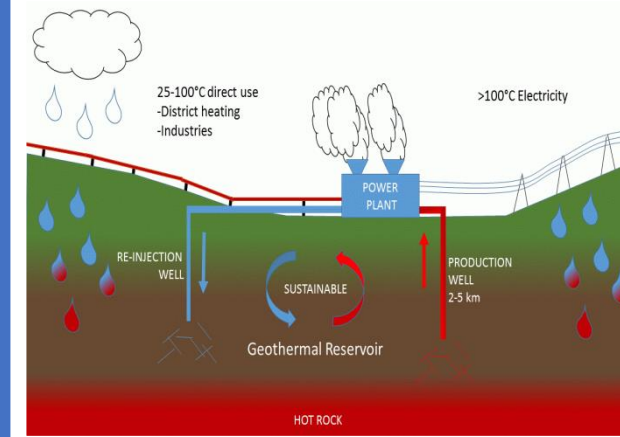




Geothermal



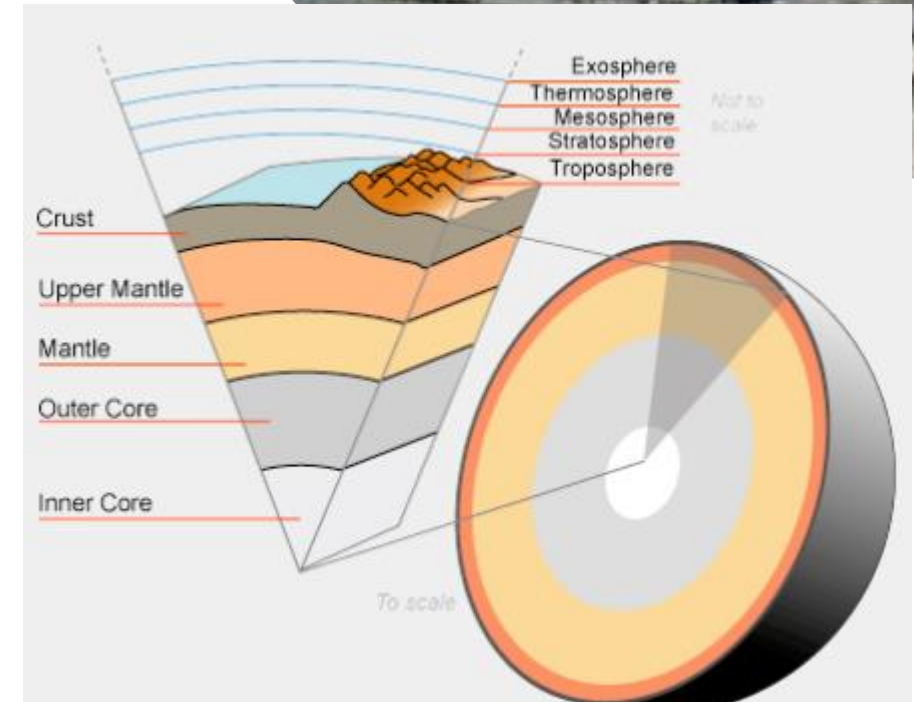
Fundamental of
Renewable
Energy

29 – 30 JANUARI 2019

Cawangan Kejuruteraan Elektrik

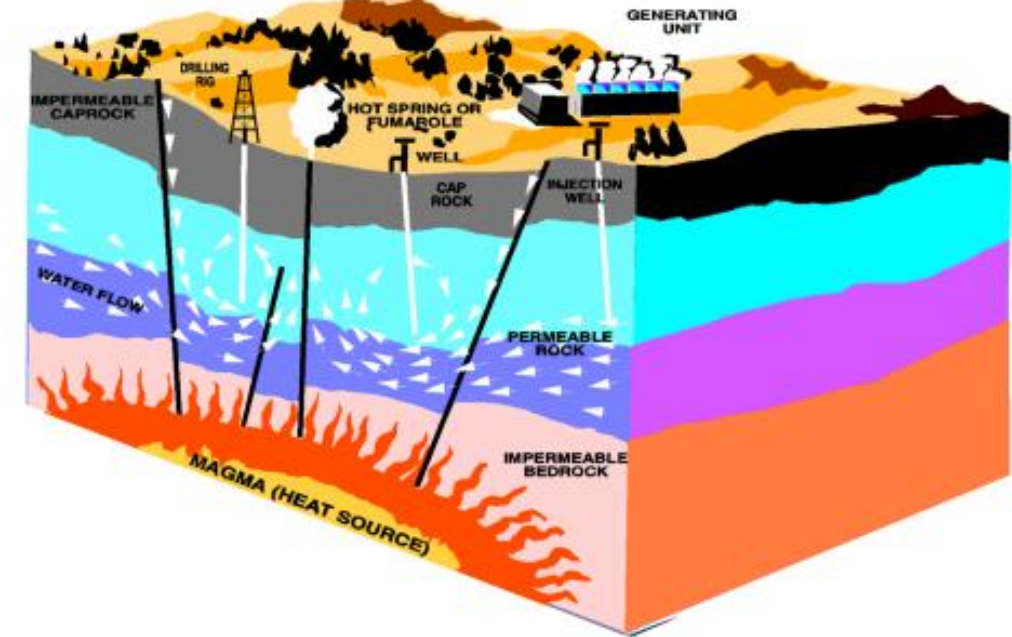
Geothermal

- Geothermal energy is the heat from the Earth
- It is clean & sustainable
- No pollution
- Cheaper than fossil fuel
- Geothermal in Greek means Geo = Earth & Therme = Heat
- Geothermal gradient is the difference in temperature between the core of the planet and its surface, drives a continuous conduction of thermal energy in the form of heat from the core to the surface



Geothermal

- Geothermal Energy has huge potential because is 50,000 times bigger from all energy that can be gained from oil and coal across the world.
- Geothermal resources are located from shallow surface to couple of km deep reservoirs of hot water springs, wells and geysers, which could be brought to surface and there exploited.
- Water or steam - Medium that is transferring heat from inner core to surface, since heat is always transferring from hotter to colder parts, this heat is the major mover of tectonic plates
- Temperature rises 50-87°F every one mile deeper from the earth's crust



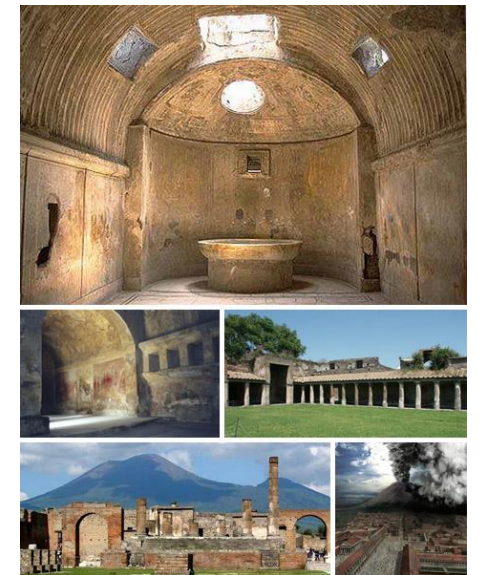
LOCATION OF GEOTHERMAL

- Best areas are on the edges of tectonic plates located on the ring of fire. **Ring of Fire** (area with high volcanic and tectonic activity)



- For millenniums for recreational-sanative bathing.
- Now, for generating electricity and as the central heating of households and buildings

1904 in Italy - First geothermal power station with power of 250Kw





Geothermal Application

Direct Use

- Heat is directly use
- It can be used for space heating, industrial processes, drying crops, hot water supply & melting snow
- Heat is extracted from low temperature source $< 150^{\circ}\text{C}$

Indirect Use

- Source temperature $> 150^{\circ}\text{C}$
- Deep wells are drilled & steam from reservoir is used to drive turbine & produce electricity

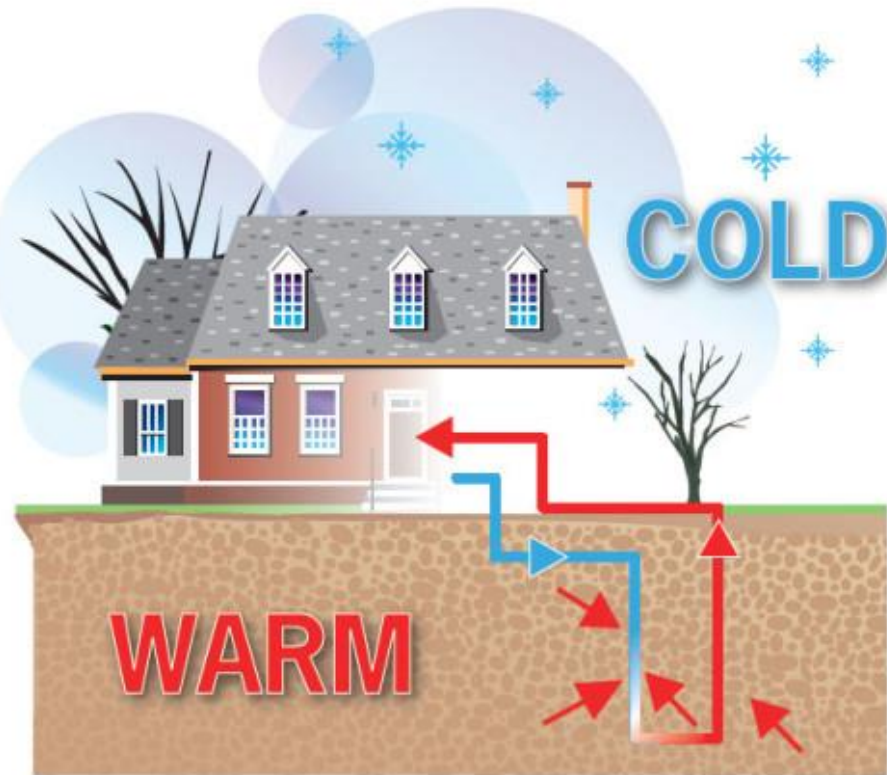
- **Direct use**

- Geothermal heating & heat pump

- **Indirect use**

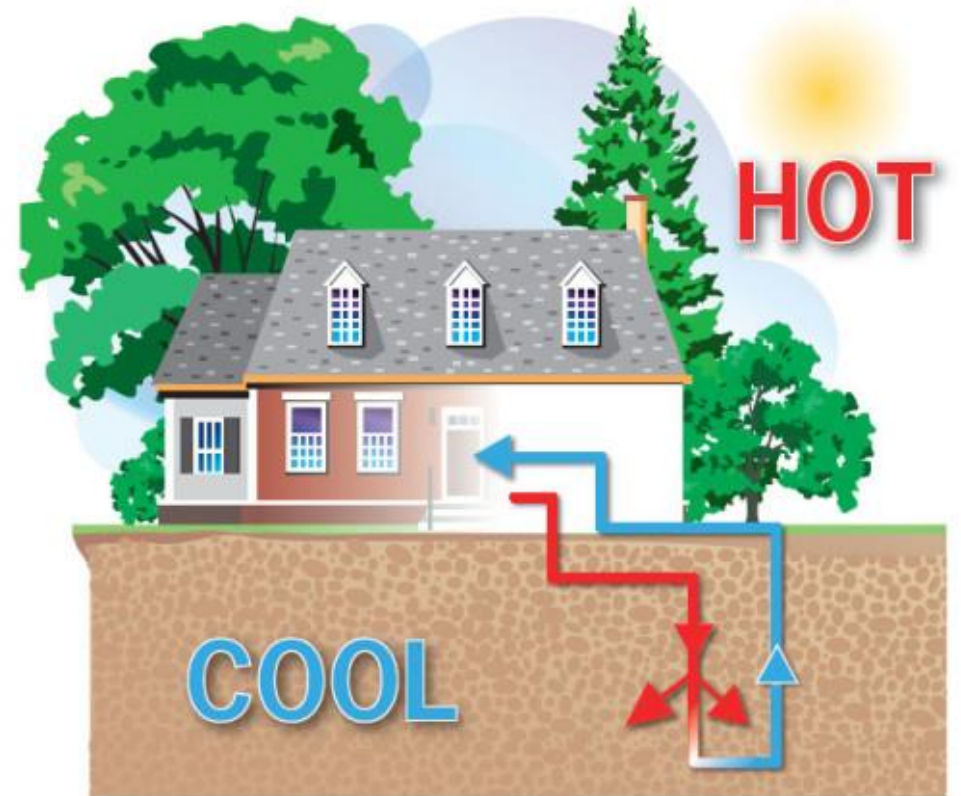
- Electricity production

Direct Use



Heating

In the winter, water circulating inside a sealed loop system absorbs heat from the earth and carries it to the heat exchanger. Here, the water is compressed to a higher temperature and is sent as warm air to your indoor system for distribution throughout your home.



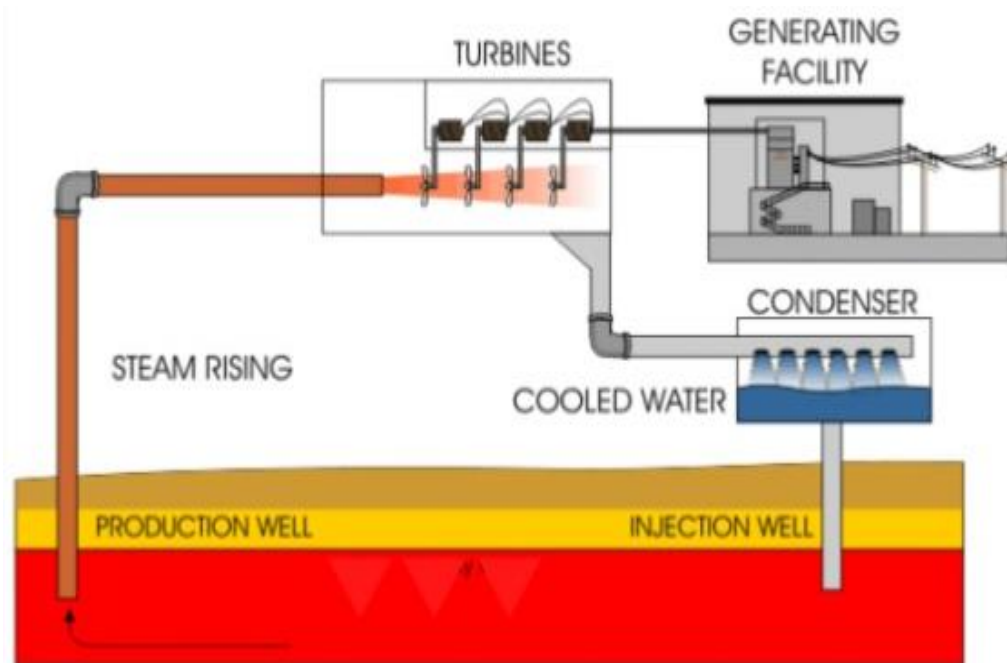
Cooling

In the summer, the system reverses and expels heat from your home to the cooler earth via the same closed loop system. This heat exchange system is not only a natural process but is a highly efficient way to create a comfortable climate in your home.

Indirect Use

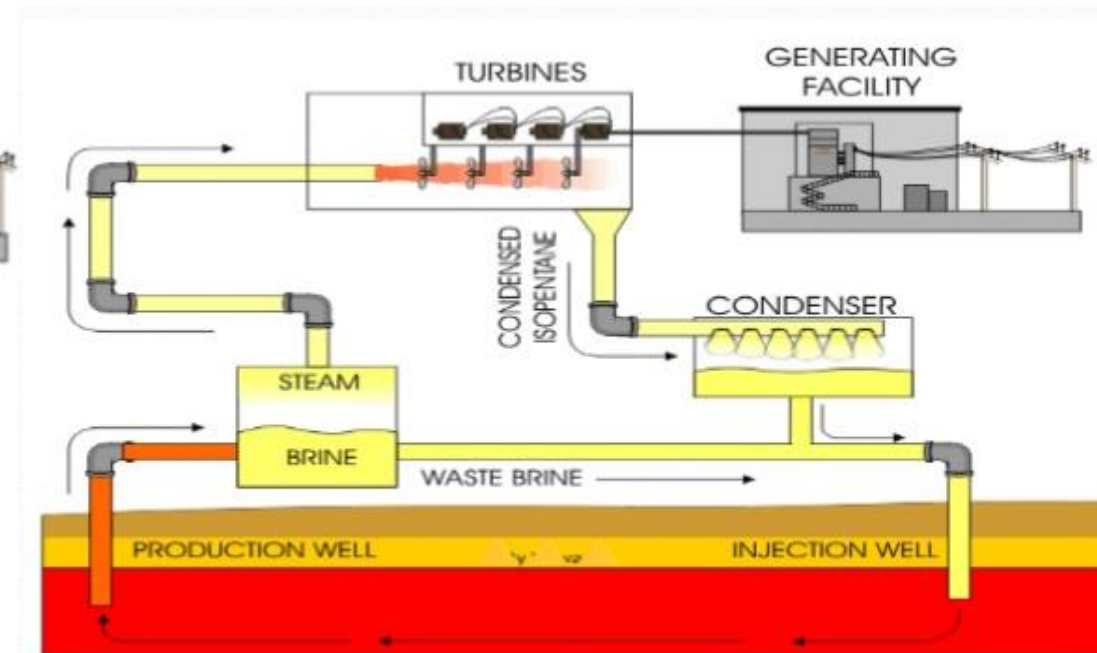
Dry steam power plant

- The oldest type of geothermal power plant
- Geothermal reservoir containing pure steam is required
- Pure dry steam drives turbines



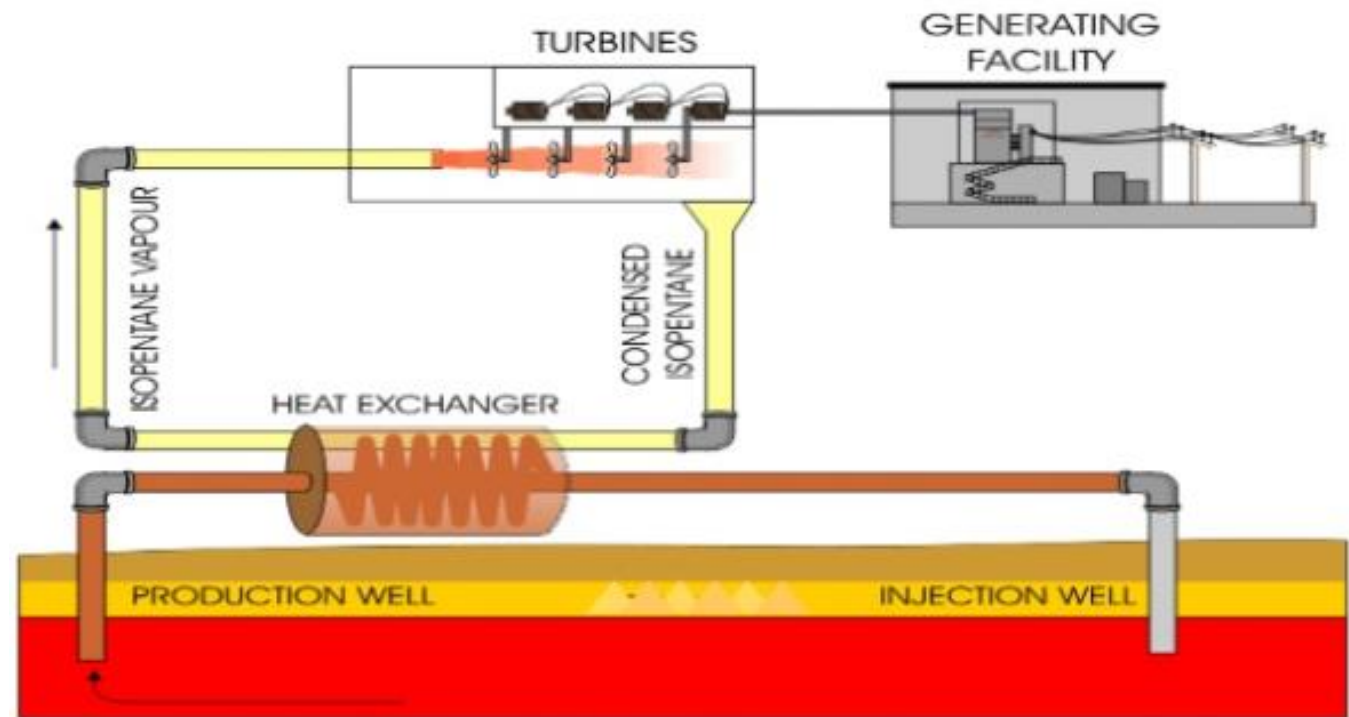
Flash steam power plant

- Commonly used
- Geothermal reservoir containing hot water & steam is required
- Pressure changing system is required



Binary steam power plant

- Does not use steam directly to spin turbines
- Only heat of the underground water is used
- Vaporized hydrocarbons are used to spin the turbine. Eg propane (low boiling temperature)
- No harmful gas is emitted to the atmosphere because the underground water is never disclosed to outside



Advantages

- Does not produce pollution & does not contribute green house effect
- The power station is compact
- No fuel needed
- Almost free energy
- Independent of weather

Disadvantages

- Initial investment is very high
- Sources are limited
- May release harmful gas, ie hydrogen sulfide
- Earthquake & volcano eruption

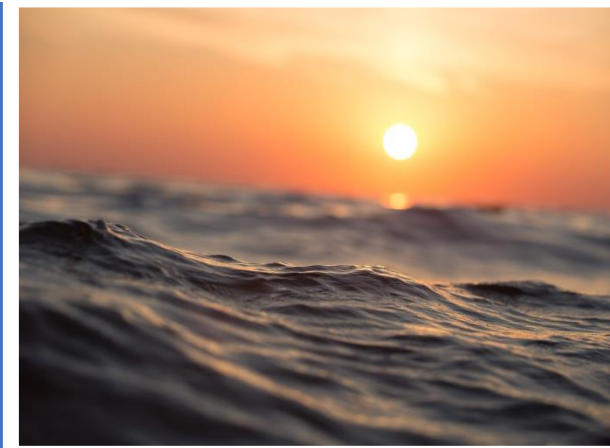
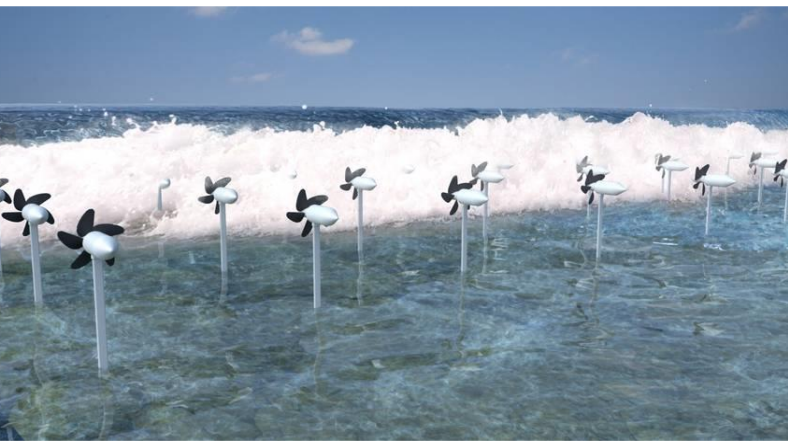


Geothermal potential in Malaysia

- Hot spring spots at Poring, and Apas Kiri near Tawau in Sabah can produce geothermal resources
- Apas Kiri hot spring is capable of producing 67 MW electric power



Wave Energy



Fundamental of
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Cawangan Kejuruteraan Elektrik

Wave Energy

Where does wave energy originate?

Differential warming of the earth causes pressure differences in the atmosphere, which generate winds

As winds move across the surface of open bodies of water, they transfer some of their energy to the water and create waves

The amount of energy transferred and the size of the resulting wave depend on

- the wind speed
- the length of time for which the wind blows
- the distance over which the wind blows, or fetch

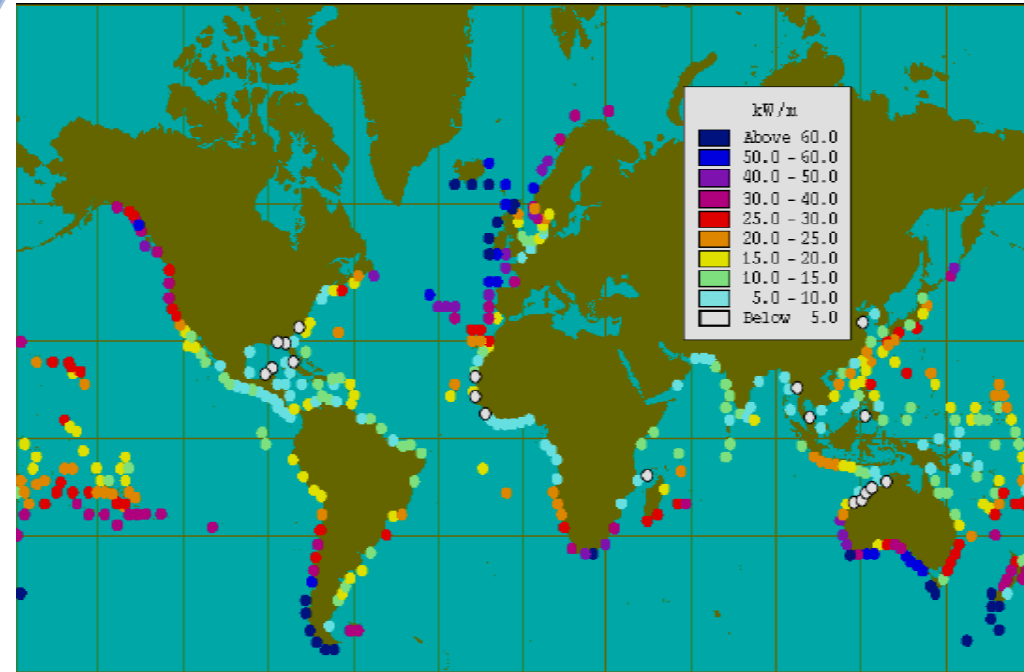


Wave Energy

The strongest winds blow between 30° and 60° in latitude.

Western coastlines at these latitudes experience the most powerful waves.

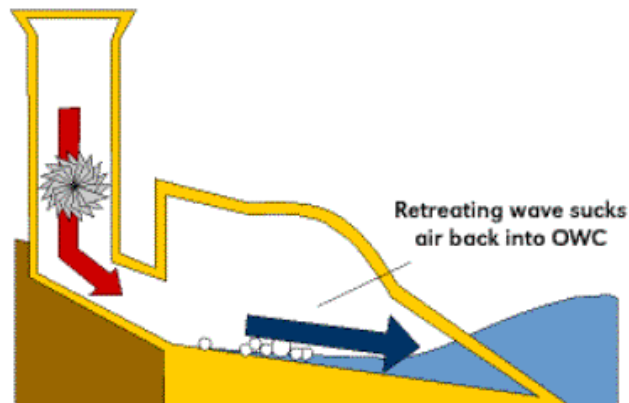
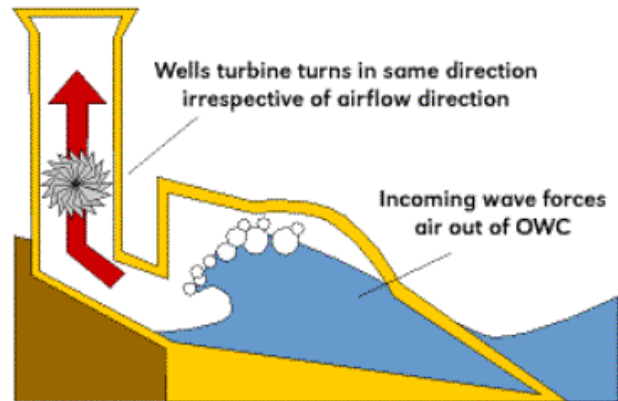
In order to extract this energy, wave energy conversion devices is required



Wave Energy Fundamental & Technologies

Waves retain energy differently depending on water depth

- Lose energy slowly in deep water
- Lose energy quickly as water becomes shallower because of friction between the moving water particles and the sea bed



- As a wave enters the collector, the surface of the water column rises and compresses the volume of air above it.
- The compressed air is forced into an aperture at the top of the chamber, moving past a turbine.
- As the wave retreats, the air is drawn back through the turbine due to the reduced pressure in the chamber.

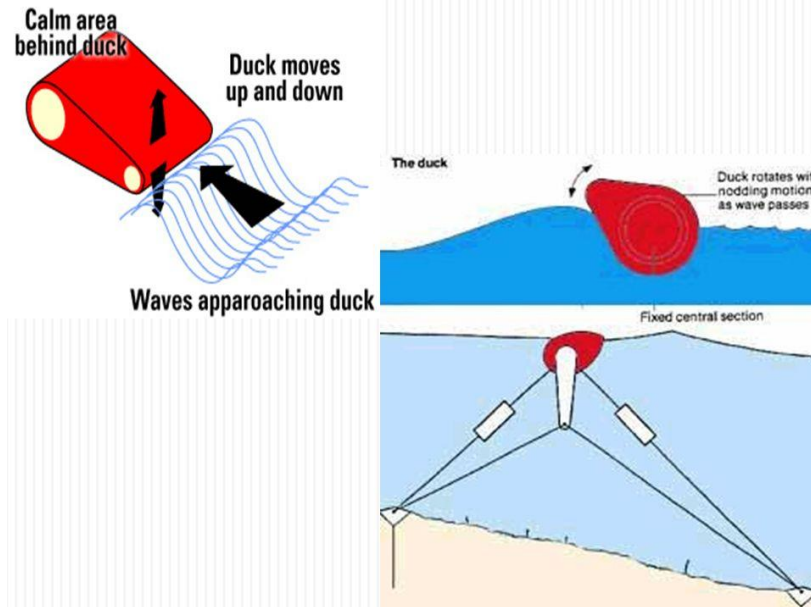
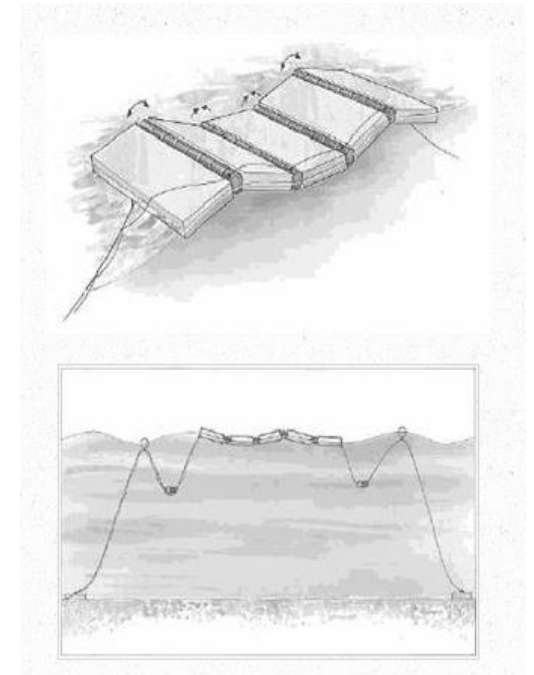


- Oscillating Water Column

Wave Energy Fundamental & Technologies

Hinge Contour Device

- Move with the wave
- The motion is resisted at the joint



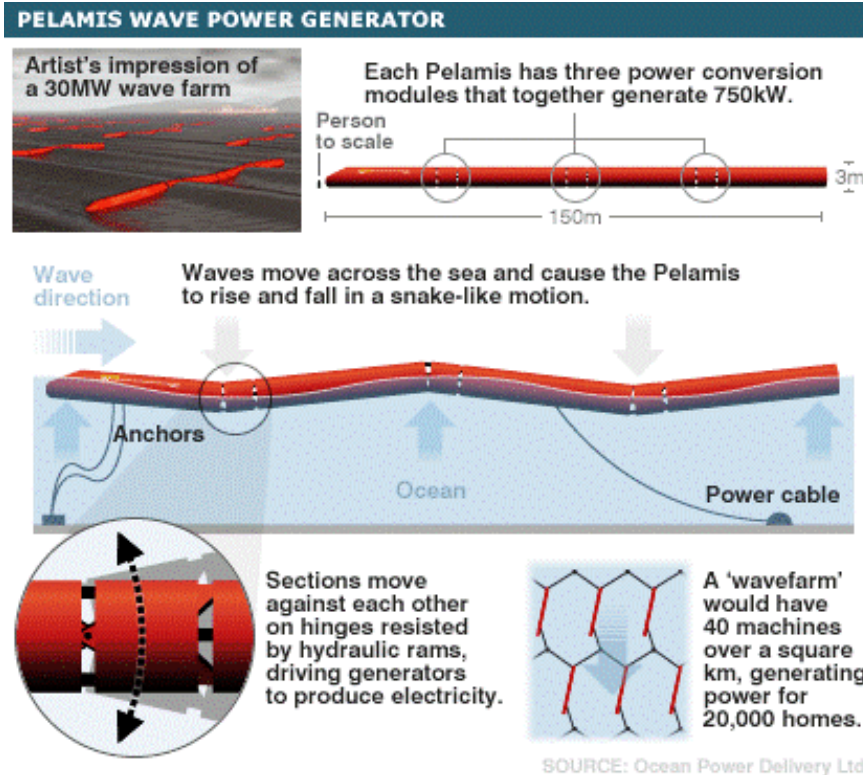
Buoyant Moored Device

- Works by rotating a long linkage
- Float on the surface of water

Wave Energy Fundamental & Technologies

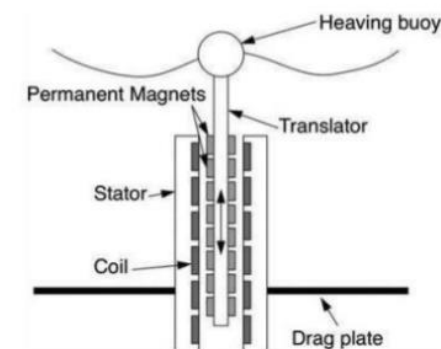
Pelamis Machine

- Floats on the surface of the water
- The rolling motion of the waves generates electricity



Energy Buoy

- Floats on the surface of the water
- The rolling motion of the waves generates electricity



Advantages

- Resources is free & will not run out
- Does not produce Green House Gasses
- Not expensive to operate & maintain
- Safe for human & environment
- High potential – ocean is everywhere

Disadvantages

- Depending on location – some may have low current
- Methods to transport energy to land
- High capital cost
- Some device produce noise & requires space
- Need to be strong & water resistance
- Impact to marine life



terima kasih