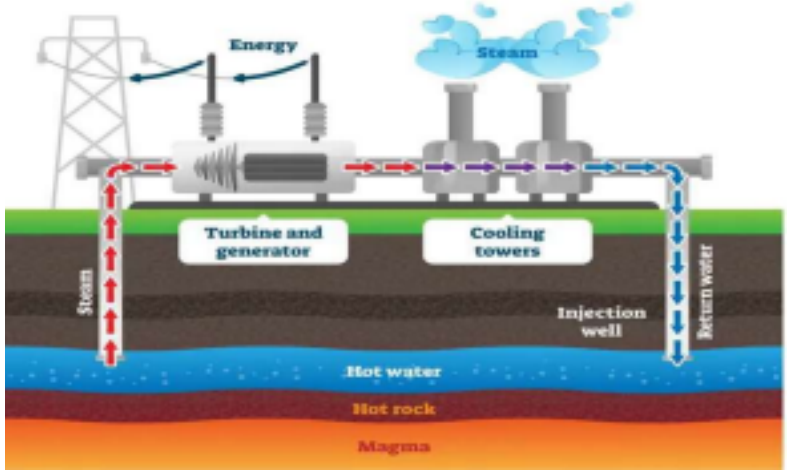
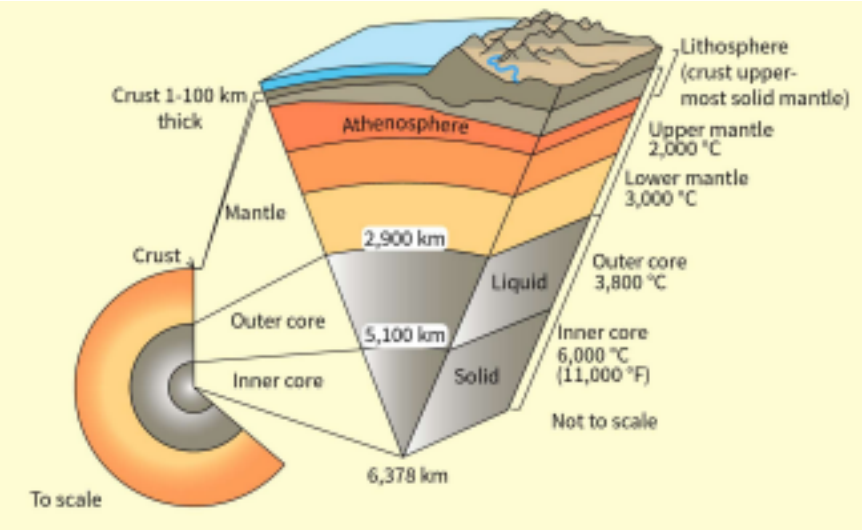


- Geothermal energy is heat ~~within the earth. The word geothermal~~ comes from the Greek words geo (earth) and ~~thermal (heat).~~
- Geothermal energy is a re~~newable energy source because~~ heat is continuously produced inside the earth.
- People use geothermal heat ~~for bathing, for heating buildings~~, and for generatingelectricity.



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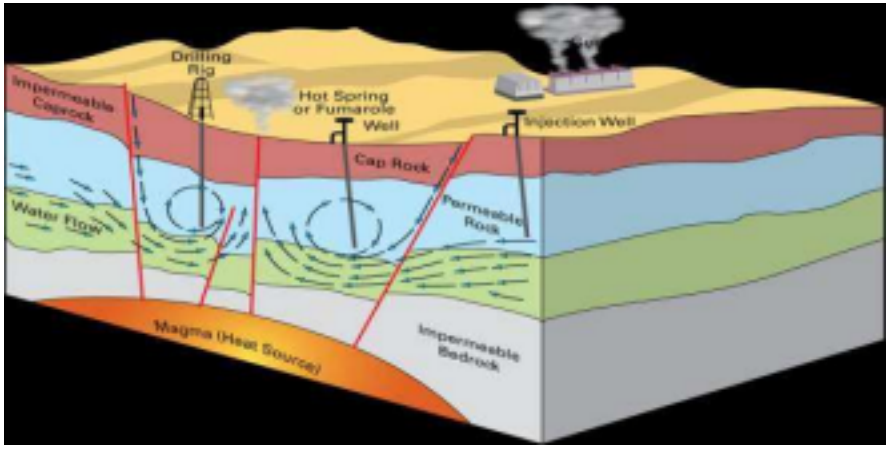


3 An inner core of solid iron that is about 1,500 miles in diameter

An outer core of hot molten rock called magma that is about 1,500 miles thick. A mantle of

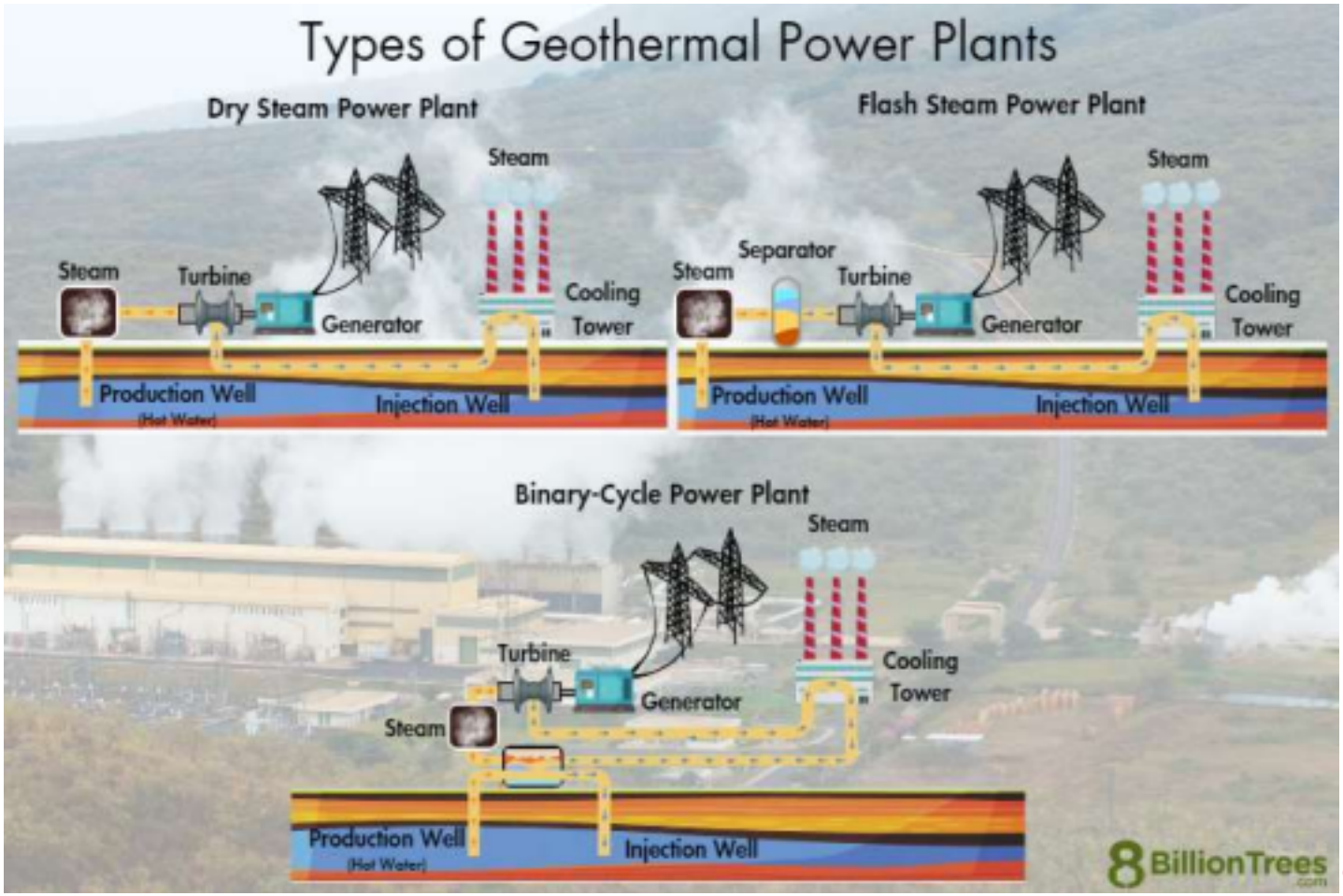
magma and rock surrounding the outer core that is about 1,800 miles thick A crust of solid rock that forms the continents and ocean floors that is 15 miles to 35 miles thick under the continents and 3 miles to 5 miles thick under the oceans

Geothermal wells have been ~~used for several~~ ~~dec~~a~~des as an~~ adjunct to existing heating and cooling systems.

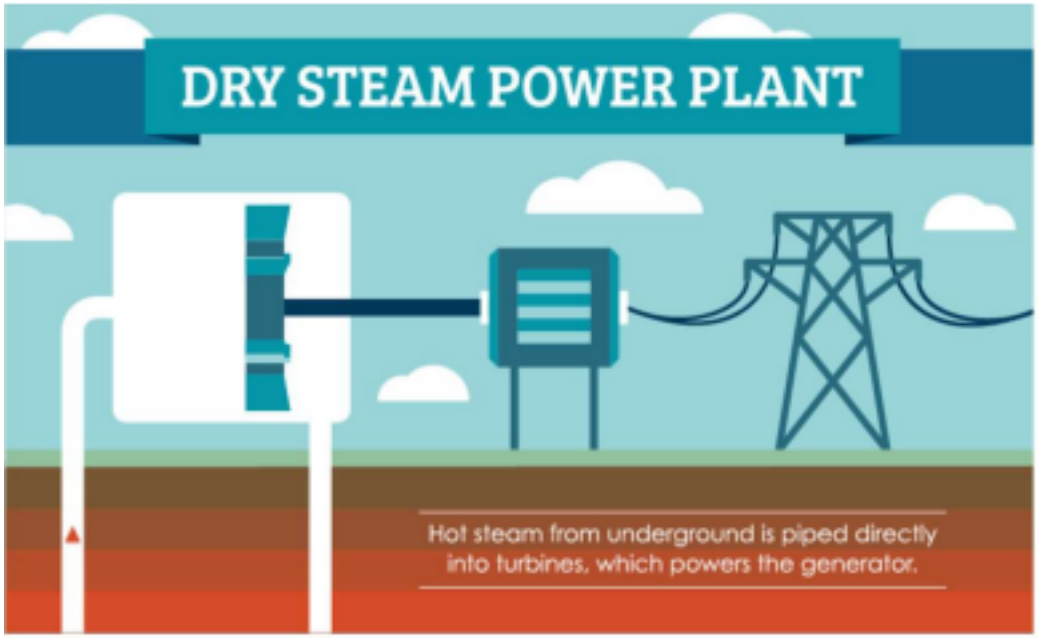
The systems are designed t~~o use the Earth's relatively c~~onstant subsurface temperature along with a heat exchanger t~~o either add to or remove heat~~ from a dwelling. Vertical loop and horizontal l~~oop systems.~~

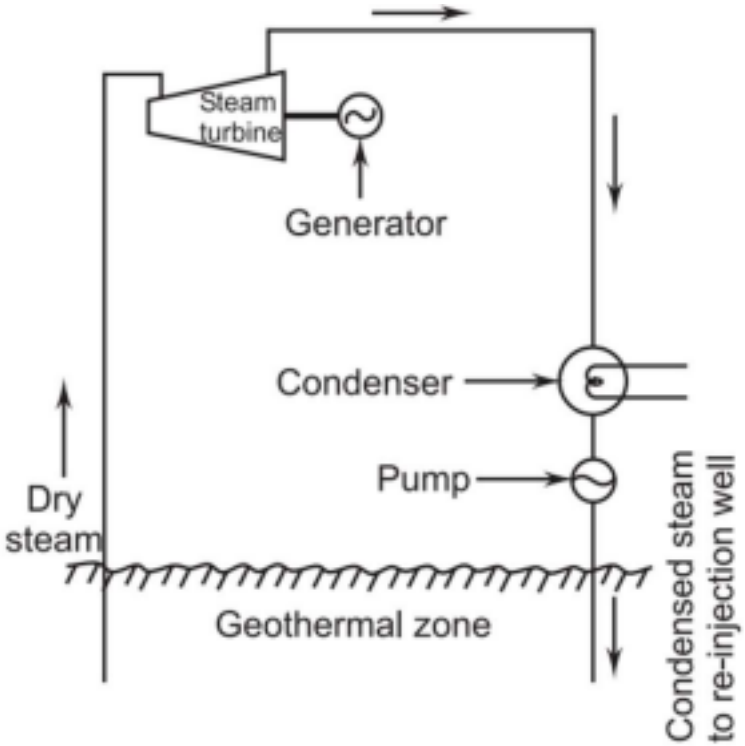
Vertical loops consist of a sing~~le pipe that extends down into~~ the earth's crust.

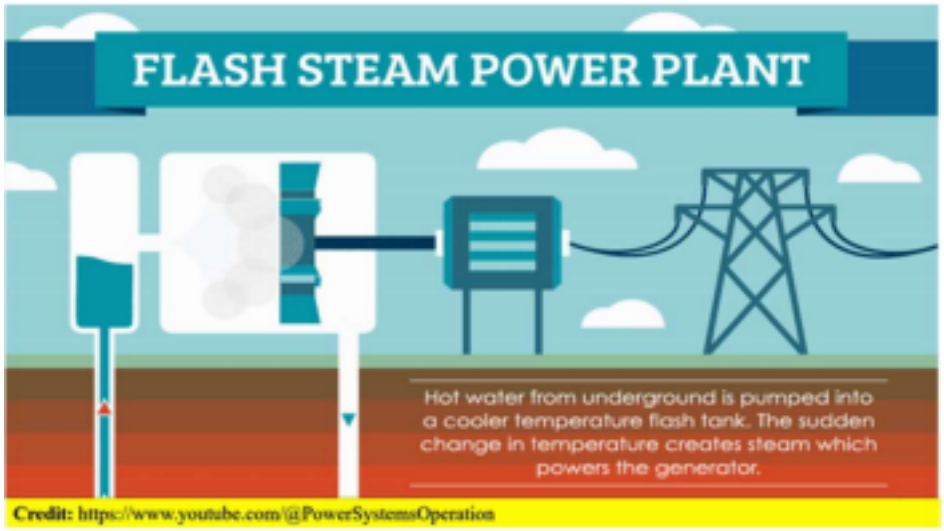
Horizontal loops consist of multiple lines arranged in parallel rows underground with one end exposed above ground.

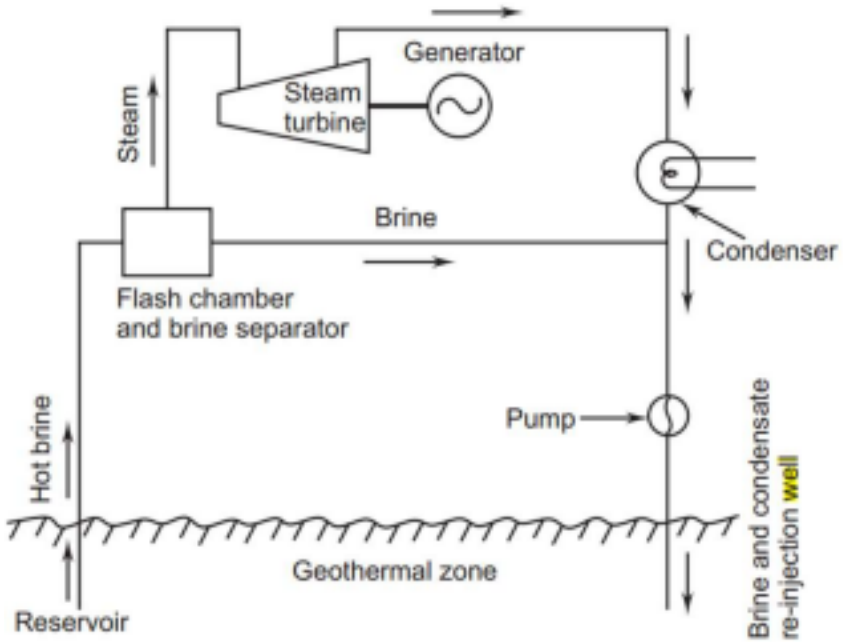


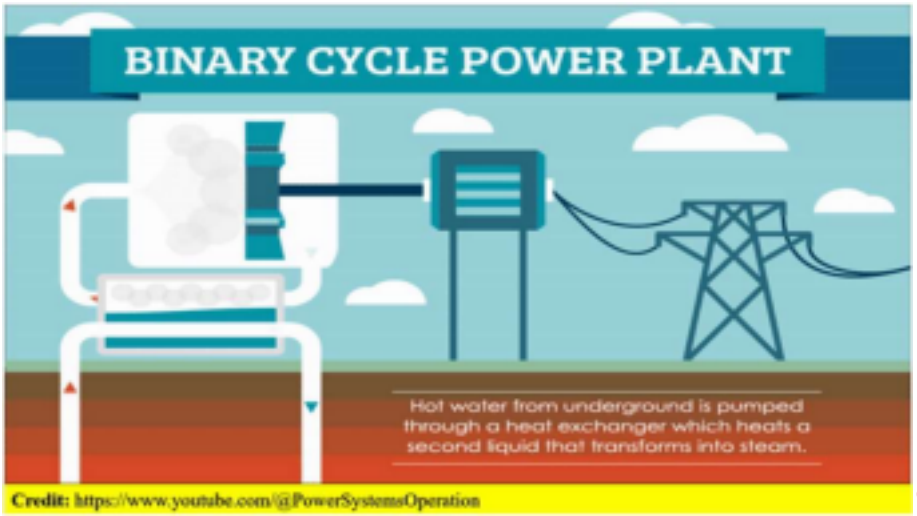
Dr Dheepanchakkravarthy A

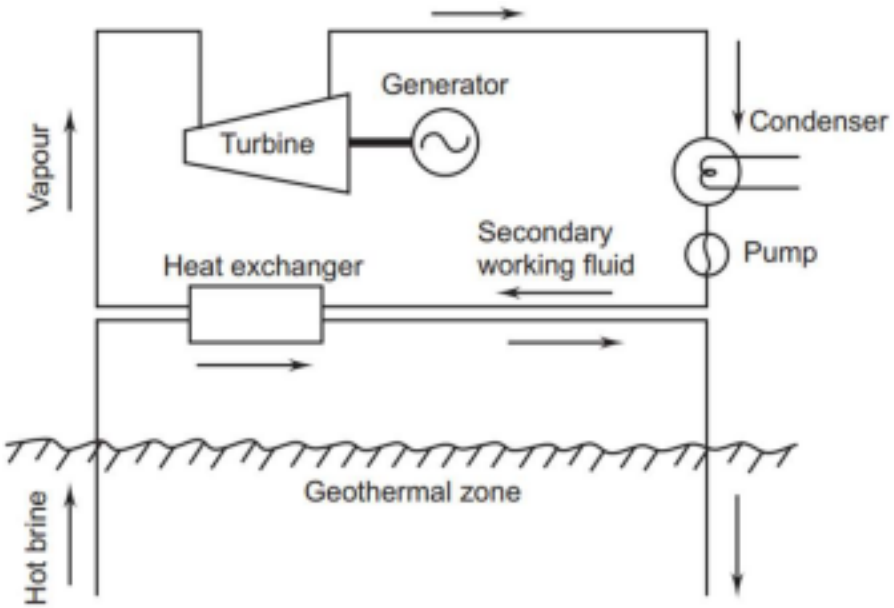

DRY STEAM POWER PLANT
Hot steam from underground is piped directly into turbines, which powers the generator.


Steam turbine
Generator
Condenser
Pump
Dry steam
Geothermal zone
Condensed steam to re-injection well


FLASH STEAM POWER PLANT
Hot water from underground is pumped into a cooler temperature flash tank. The sudden change in temperature creates steam which powers the generator.
Credit: https://www.youtube.com/@PowerSystemsOperation


Generator
Steam
turbine
Steam
Brine
Condenser
Flash chamber
and brine separator
Pump
Hot brine
Brine and condensate
re-injection well
Geothermal zone
Reservoir


BINARY CYCLE POWER PLANT
Hot water from underground is pumped through a heat exchanger which heats a second liquid that transforms into steam.
Credit: https://www.youtube.com/@PowerSystemsOperation



- Geothermal energy is cheaper.
- It is versatile in ~~its use.~~
- It is the least po~~lluting as compared to other conventional energy sources.~~
- It is amenable ~~for multiple uses from a single resource.~~
- Geothermal po~~wer plants have the highest annual load factors of 85 per c~~ent

to 90 per cent compared to 45 per cent to 50 per cent for fossil fuel plants. It delivers greater amount of net energy from its system as compared to other alternative or conventional systems

- Low overall power production efficiency (about 15% as compared to 35 to 40% for fossil fuel plants).
- Drilling operation is noisy.
- Large areas are needed for exploitation of geothermal energy.
- The withdrawal of large amounts of steam or water from a hydro-thermal reservoir may result in surface subsidence or settlement.

- Generation of electric power.
- Plastic manufacture.
- Paper manufacture.
- Space heating for buildings.
- Industrial process heat
- Crop drying.
- Mushroom culture.
- Timber seasoning.
- Production of salt from sea.
- Sewage heat treatment

- Ocean energy refers to all forms of renewable energy derived from the sea.
- There are three main types of ocean technology: wave, tidal and ocean thermal.
- All forms of energy from the ocean are still at an early stage of commercialization.
- Wave energy remains more costly than the other ocean technologies.

- Warm water (low density due to higher temperature) on

the ocean's surface flows from tropics towards poles.

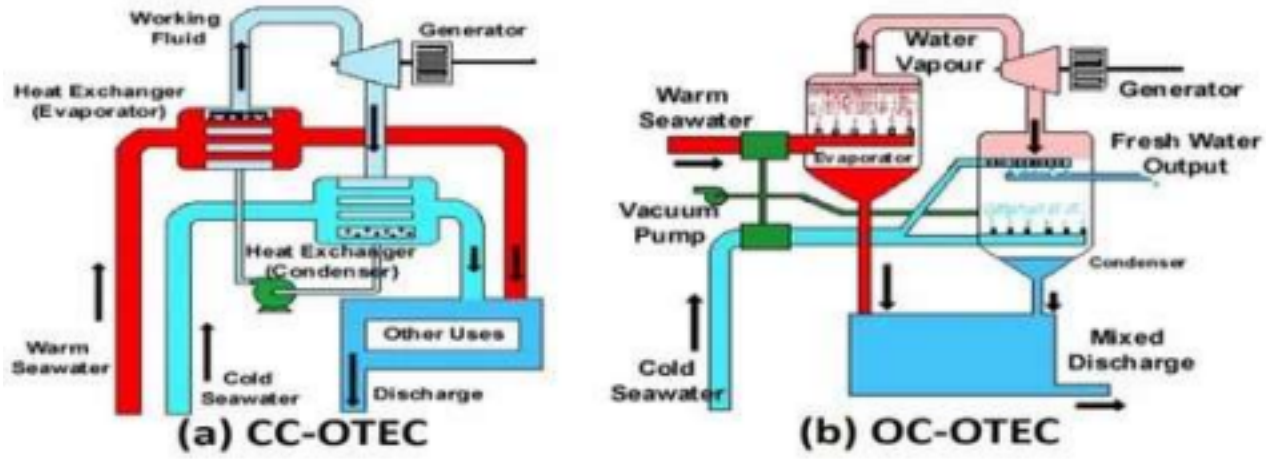
- Cold water (high density due to low temperature) circulates at the ocean bottom from the poles to tropics.
- Hence, in tropical regions, the water temperature is around 5°C at a depth of 1000 m, whereas at the surface, it remains almost constant at 25°C (range being 24°C to 27°C) for the first fewmeters because of mixing; subsequently it decreases and asymptotically approaches the value at the lower level.

- Power obtained from OTEC plant is renewable and eco-friendly.
- The plant can operate in remote islands and sea shore continuously.
- According

to MNRE, the overall potential of ocean energy in India may be in excess of 50,000 MW, and as such there is an enormous opportunity to this renewable source of energy.

- There is a temperature difference between water at the bottom of the sea and water at the top, this temperature difference can be used to operate a heat engine.
- Most of the radiation is being absorbed at the surface layer of water. The mixing between hot and cold water is prevented because no thermal convection occurs between hot and cold water
- This means that the surface layer will act as a "source" and cold layers act as a "sink".Therefore, it is essential to connect the reversible heat

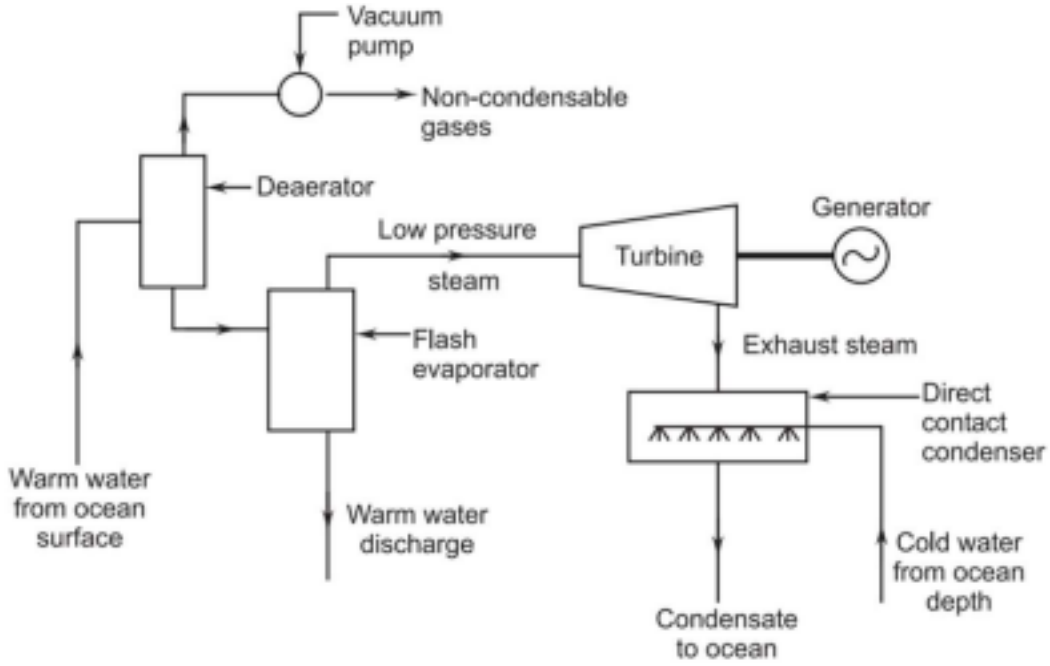
engines between source and cold sink to produce work, that can be converted into required applications.layers.



- The plants which employ carnot-type process to generate power between the two steady temperatures are called Ocean Thermal Energy Conversion (OTEC) plants. Open cycle (or Claude cycle) system Closed cycle (or Anderson cycle) system

- Uses a low-boiling point fluid, like ammonia or propane, to generate electricity from the ocean's warm surface water

- ~~The warm surface water is used for~~ supplying ~~the heat input in the 'boiler', while cold water brought up~~ from ocean depths is used for extracting the heat in the 'condenser'.



The warm water is converted into 'steam' in an evaporator. The steam drives steam-turbine ~~generator to deliver electrical energy.~~

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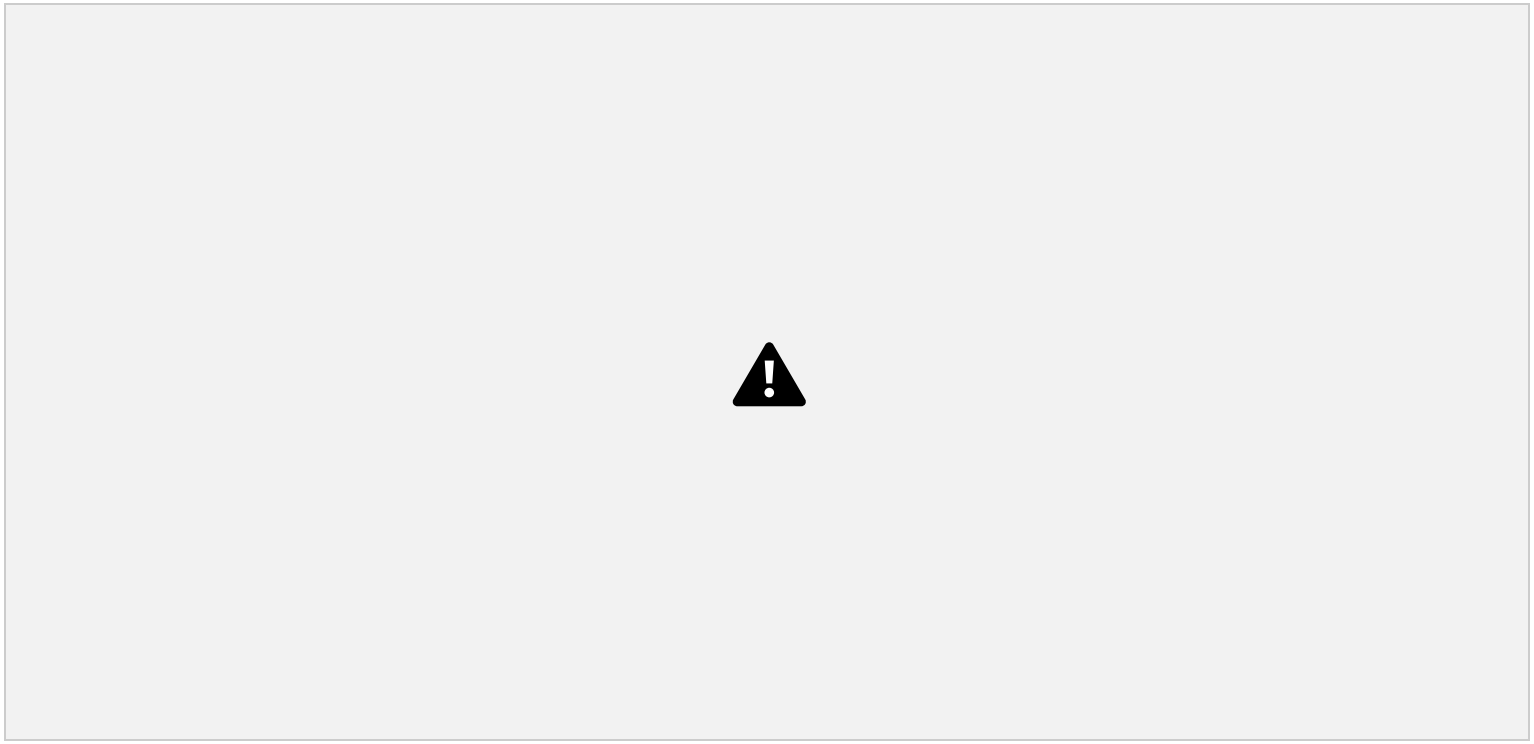

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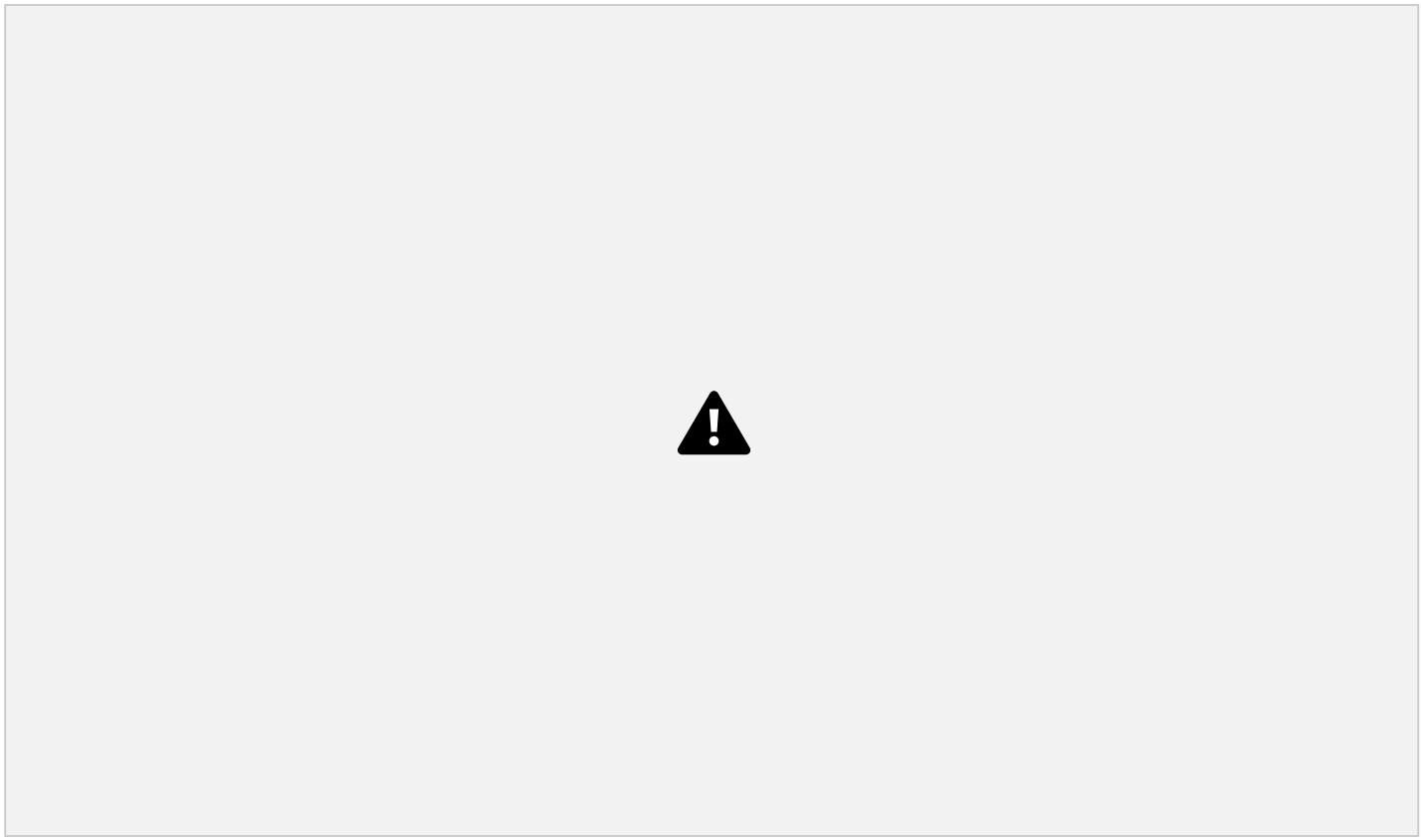
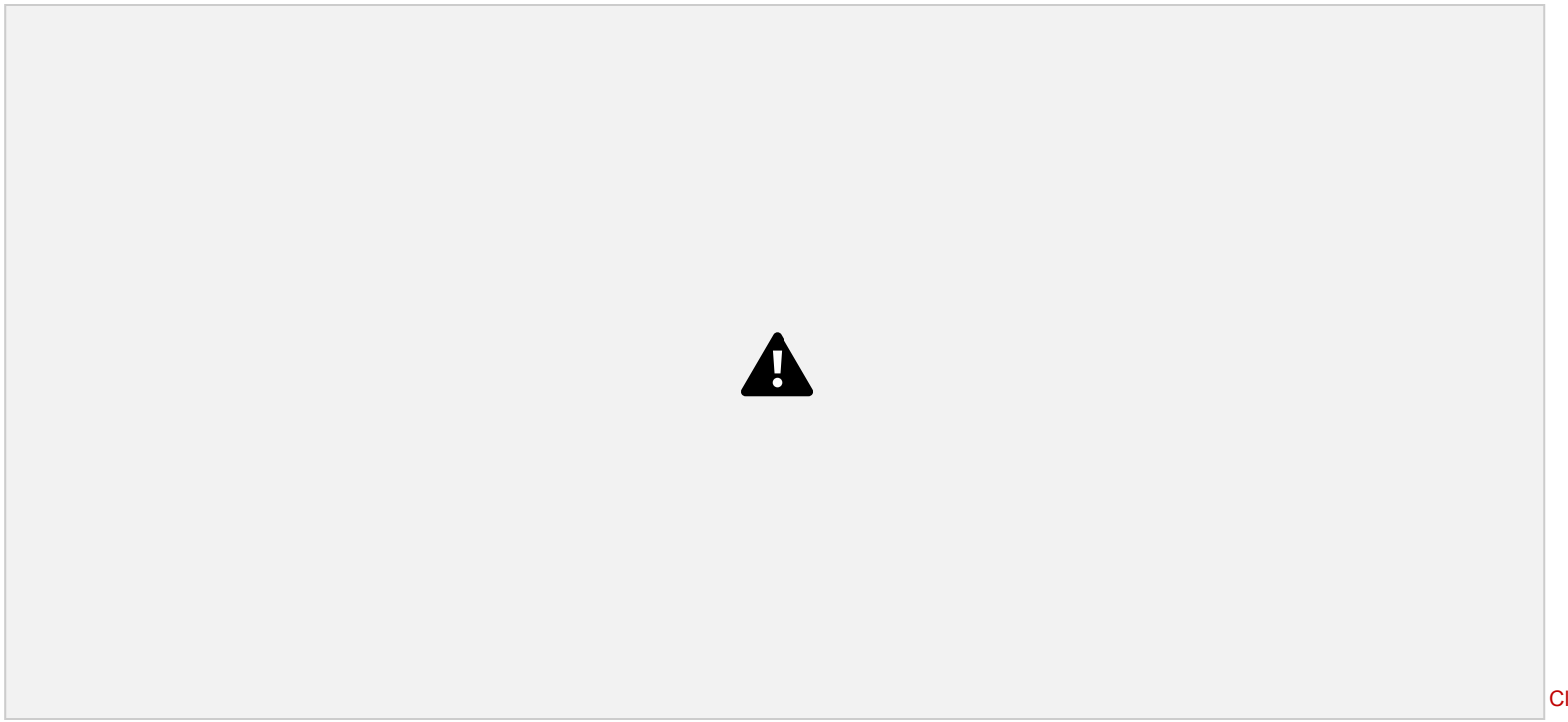
To which generates electric power and fresh water





1. It is clean form ~~of energy conversion.~~
2. It does not occu~~py land areas.~~
3. No payment for ~~the energy required~~.
4. It can be a stead~~y source of energy since the temperatures are al~~most steady

1. About 30 percent of the power generated would be used to pump water.

2. The system would have to withstand strong convective effect of sea water; hurricanes and presence of debris and fish contribute additional hazard. 3. The materials used will have to withstand the highly corrosive atmosphere & working fluid. 4. Construction of floating power plants is difficult. 5. Plant size is limited to about 100 MW due to large size of components.

1. A closed cycle OTEC plant can also act as a chemical treatment plant.
2. An OTEC plant can also be used to pump up the deep ocean water and this cold water may be used for cooling houses, air-conditioning systems etc. 3. The

enclosing area of OTEC can be used for aquaculture and mariculture. 4. The deep ocean cold water is rich in nutrients and can be used for various applications. 5. OTEC plants are quite suitable for cogeneration of electricity and fresh water.