

ENERGY

Class Lecture-2: Pictures

**Dr. Ravi P. Agrahari
(Faculty of KSG, IIT Delhi,
Author of Mc Graw Hill)**

HCNG

Hydrogen Enriched CNG (HCNG)

HCNG is a mixture of compressed natural gas (CNG) and some percentage of Hydrogen for heat or energy generation. HCNG which may be used as a fuel of Internal Combustion Engine (ICE) is considered a cleaner source of fuel, more powerful and offers more mileage than even CNG.

Some advantages of HCNG:

- HCNG reduces emissions of CO up to 70%.
- Enables up to 5 % savings in fuel.
- Better performance due to higher Octane number.

In 2018, Delhi Government has tied up with Indian Oil Corporation Limited (IOCL) to study the technology and infrastructure needs to induct 50 HCNG buses on a trial basis. IOCL has plans to mix (18-20) % Hydrogen in these buses. Current cost of H₂ is more than the cost of Natural Gas. So, HCNG's costly than CNG.

RENEWABLE ENERGY TARGET

Table 3.5 Total Renewable Energy Installed Capacity and 2022 Targets in India

Sources	Total Installed Capacity (MW)	2022 target (MW)
Wind Power	34,046	60,000.00
Solar Power (SPV)	21,651	100,000.00
Biomass Power (Biomass and Gasification and Bagasse Cogeneration)	8,701	10,000.00
Waste to Power	138	
Small Hydro Power	4,486	5,000
Total	69,022	175,000.00

Table 3.4 Growth of Renewable Energy

	Commissioned/ pipeline (GW)	FY 19 (GW)	FY 20 (GW)	Total (GW)
Solar	49.49	34	30	113.49
Wind	46.65	10	10	66.65
Small Hydro	4.98	0.5	0.5	5.98
Bio-mass	9.5	0.5	0.5	10.5
Floating solar and offshore wind	0	16	15	31
Total	110.62	61	56	227.62

Floating Solar Plant

Note:The largest floating solar plant to date is a 2MW one in Vishakhapatnam. Another is a 500-kWh plant built by the Kerala State Electricity Board at the Banasura Sagar Dam.

WIND ENERGY

Wind Energy

- Now a day's wind turbine is capable to utilise wind into electricity generation.
- It is a specific property of blade which is developed with specific aerodynamic shape and other performance-enhancing equipment.
- To take advantage of faster and less turbulent winds, they need to be mounted at 100 feet (30 metres) or more above ground.

- When blowing wind turns the wing, it will utilize to generate electricity with the help of generator those attached with this.
- At this low speed of rotation, generator can not produce any meaningful electricity. So before connecting to the generator the speed of shaft is increased in a gearbox. The gearbox uses a planetary gear set arrangement to increase the high speed ratio. (upto 1:90)

- Minimum wind speed for power generation is required 8 Km/Hour (or 2 mt/Sec) and in maximum speed which can be used for power generation is reported 36 - 54 Km/Hour.
- 10-12 Km/Hour is the average speed of wind in India.
- **Wind vane** is utilized to check wind direction.

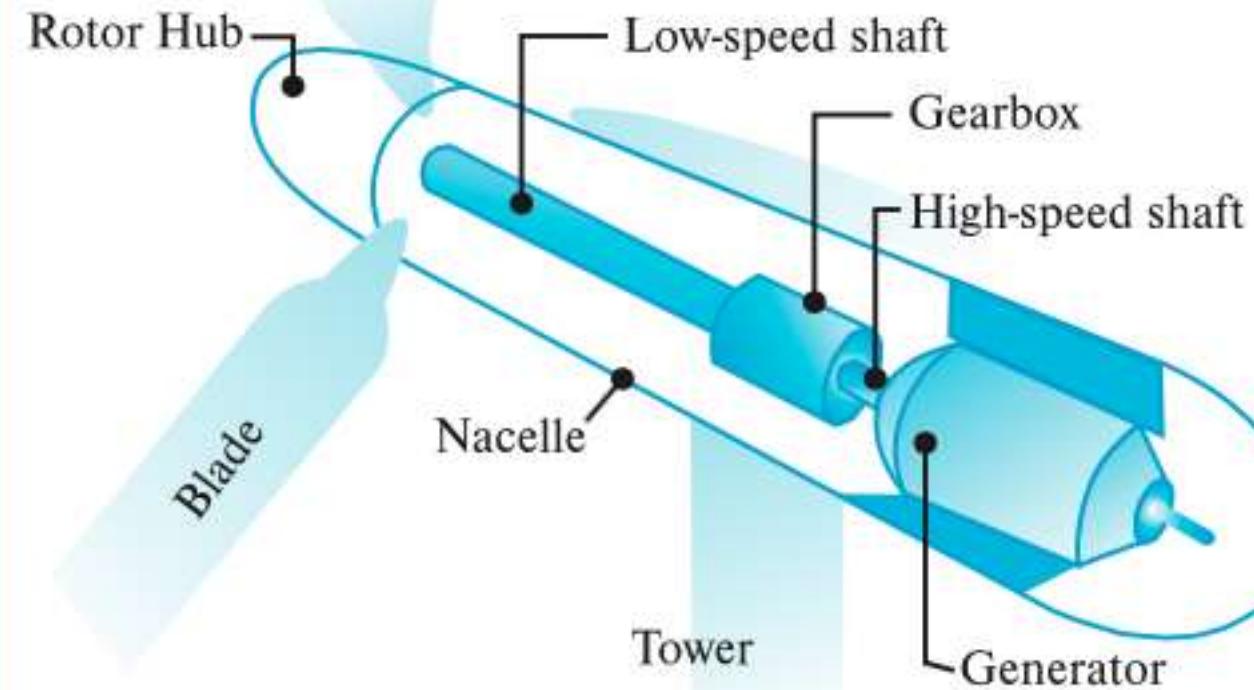


Fig. 3.2 Nacelle

- In 1986, the development of wind power in India began with the first windfarms being set up in coastal areas of Maharashtra (Ratnagiri), Gujarat (Okha) and Tamil Nadu (Tuticorin) with 55 kilowatts Vestas wind turbines.
- In India, Tamil Nadu is a leading state for wind energy generation. The maximum wind power capacity among Indian states is that of Tamil Nadu, with around 29 percent of India's total wind power capacity.

- Maharashtra (2nd rank), Rajasthan (3rd rank), Gujarat (4th rank), Karnataka (5th rank), Madhya Pradesh (6th rank) and Andhra Pradesh (7th rank) are the next constitutive states in India in wind energy generation.
- The MNRE had set the target for wind power generation capacity by the year 2022 at 60,000 megawatts, in the year 2015.

Geothermal energy

- The heat from the Earth generates another renewable (that is clean and sustainable) form of energy called geothermal energy.
- At a depth of more than 80 km, heat is available normally. In certain location at a depth of 300 mt. - 3000 mt have also presented of geothermal energy i.e. called as **geothermal field**.
- Worlds first geothermal power plant setup in **Larderello (Italy)**, 1911.

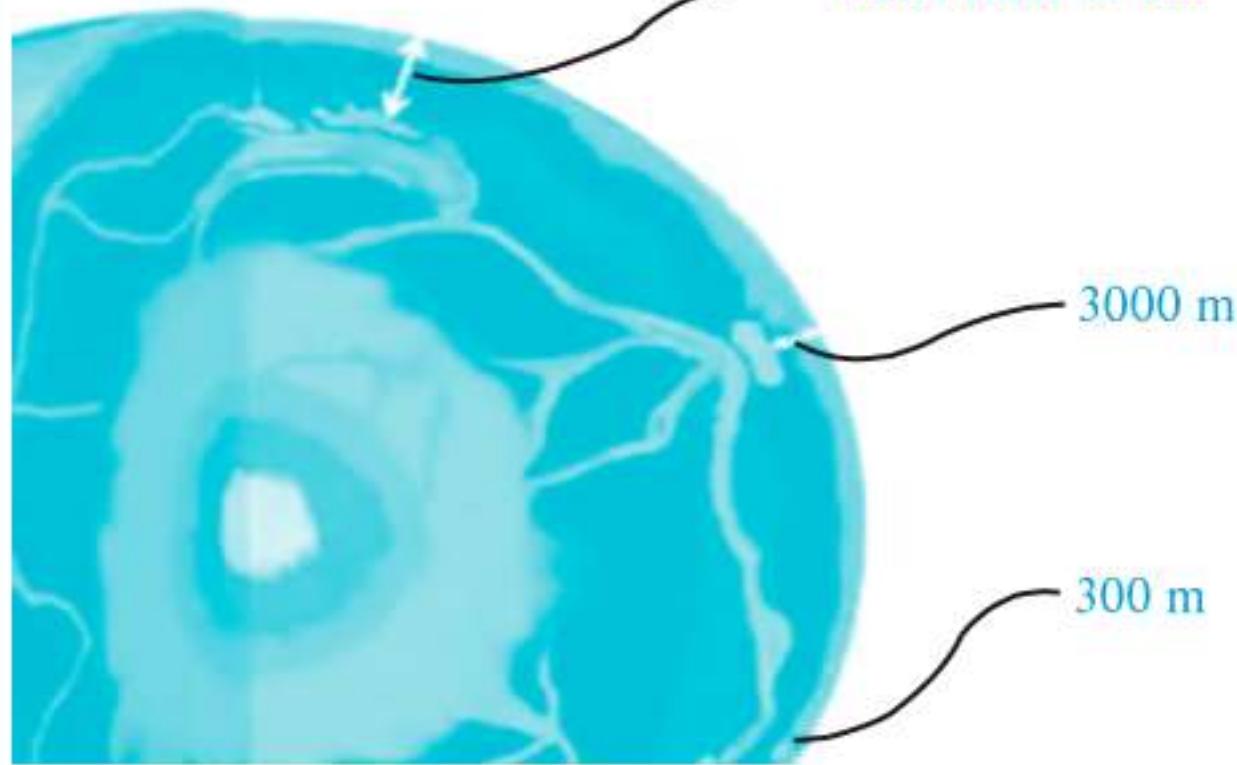


Fig. 3.4 Prexnie of heat inside the Earth

There are three types of Geothermal Power Plant setup worldwide:

- 1. Dry Steam Power Plant**
- 2. Flash Steam Power Plant – Geothermally heated water (Temp. Over 350 Fahrenheit)**
- 3. Binary Cycle Power Plant – Geothermally heated water (temp. Up-to 100 Fahrenheit)**

1. Dry Steam Power Plant

- Dry steam **plants are the most common types of geothermal power plants, accounting for about half of the installed geothermal plants.**
- **They work by piping hot steam from underground reservoirs directly into turbines from geothermal reservoirs, which power the generators to provide electricity.**

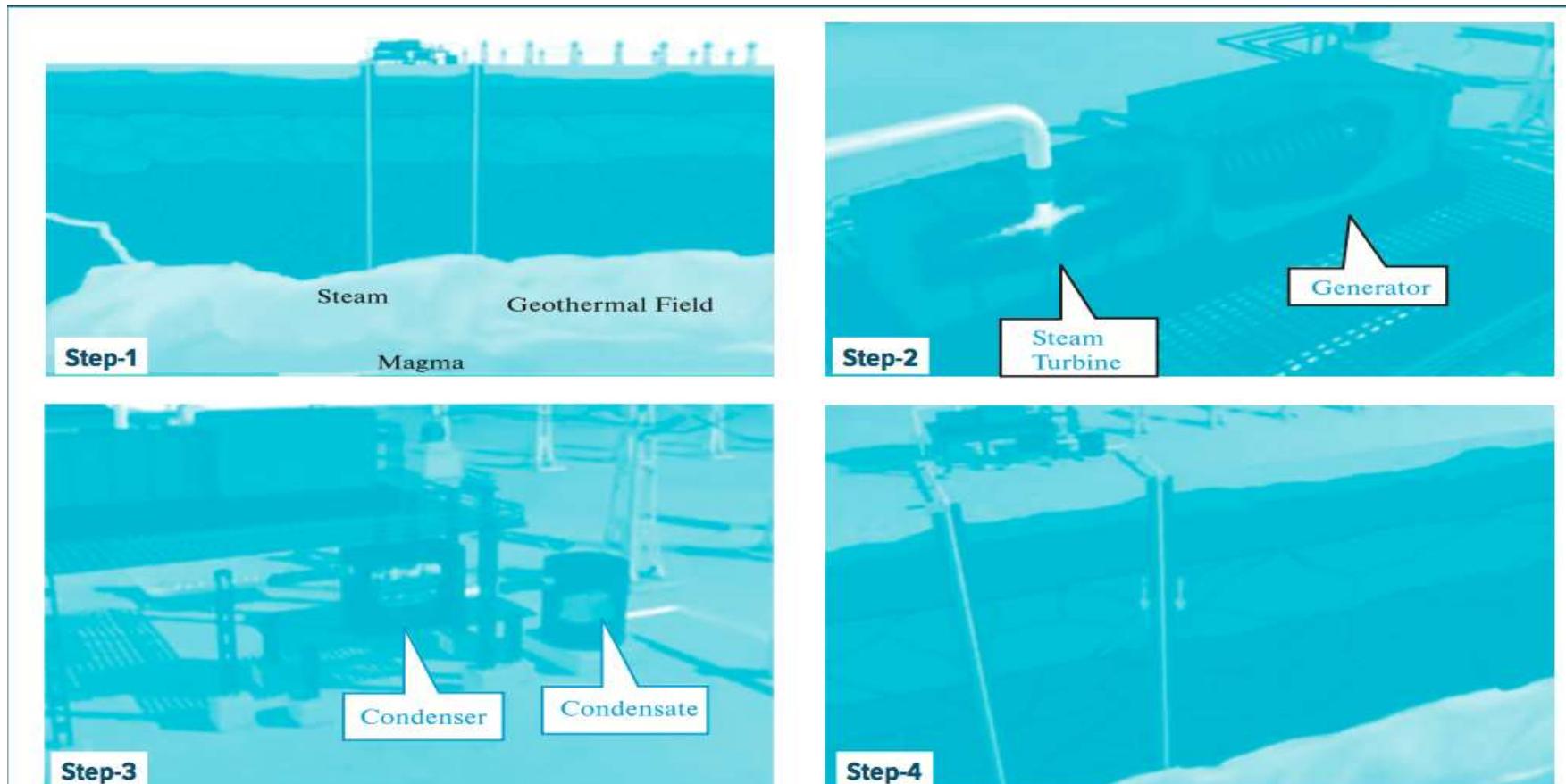


Fig. 3.5 Dry Steam Poloer Plant System (Step 1-4)

2. Flash Steam Power Plant

Flash steam plants take high-pressure hot water from deep inside the earth and convert it to steam to drive generator turbines.

When the steam cools, it condenses to water and is injected back into the ground to be used again.

Most geothermal power plants are flash steam plants.

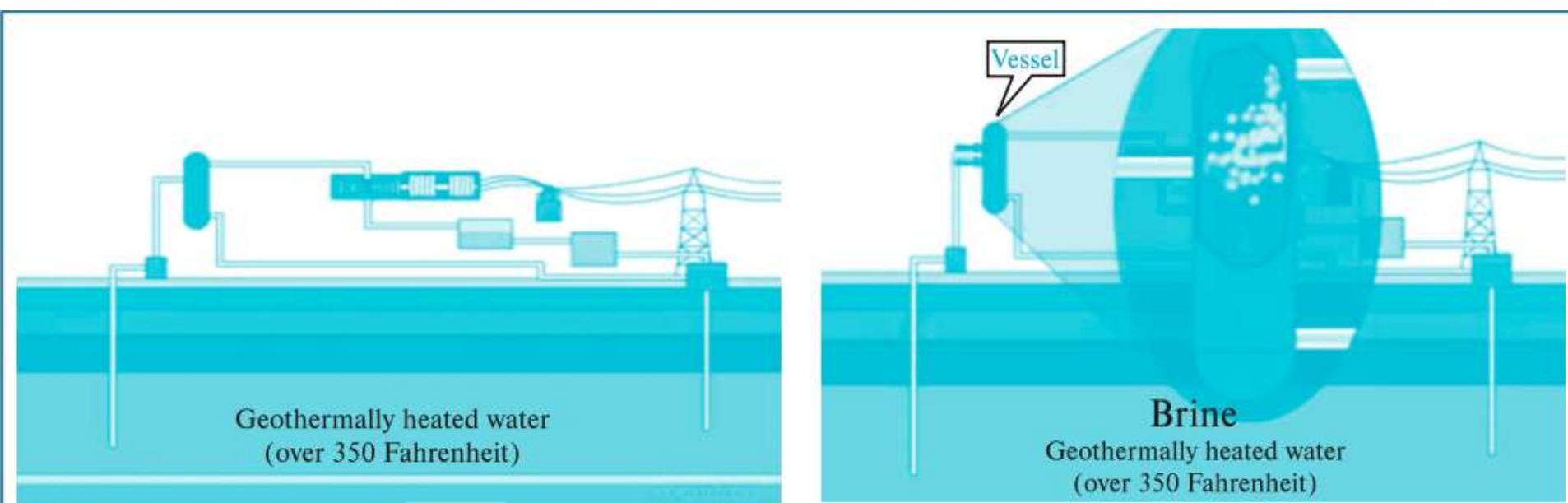


Fig. 3.6 Flash Steam Power Plant System

3. Binary Cycle PowerPlant

Binary cycle geothermal power generation plants differ from Dry Steam and Flash Steam systems in that the water or steam from the geothermal reservoir never comes in contact with the turbine/generator units.

A binary vapor cycle is defined in thermodynamics as a power cycle that is a combination of two cycles, one in a high temperature region and the other in a lower temperature region.

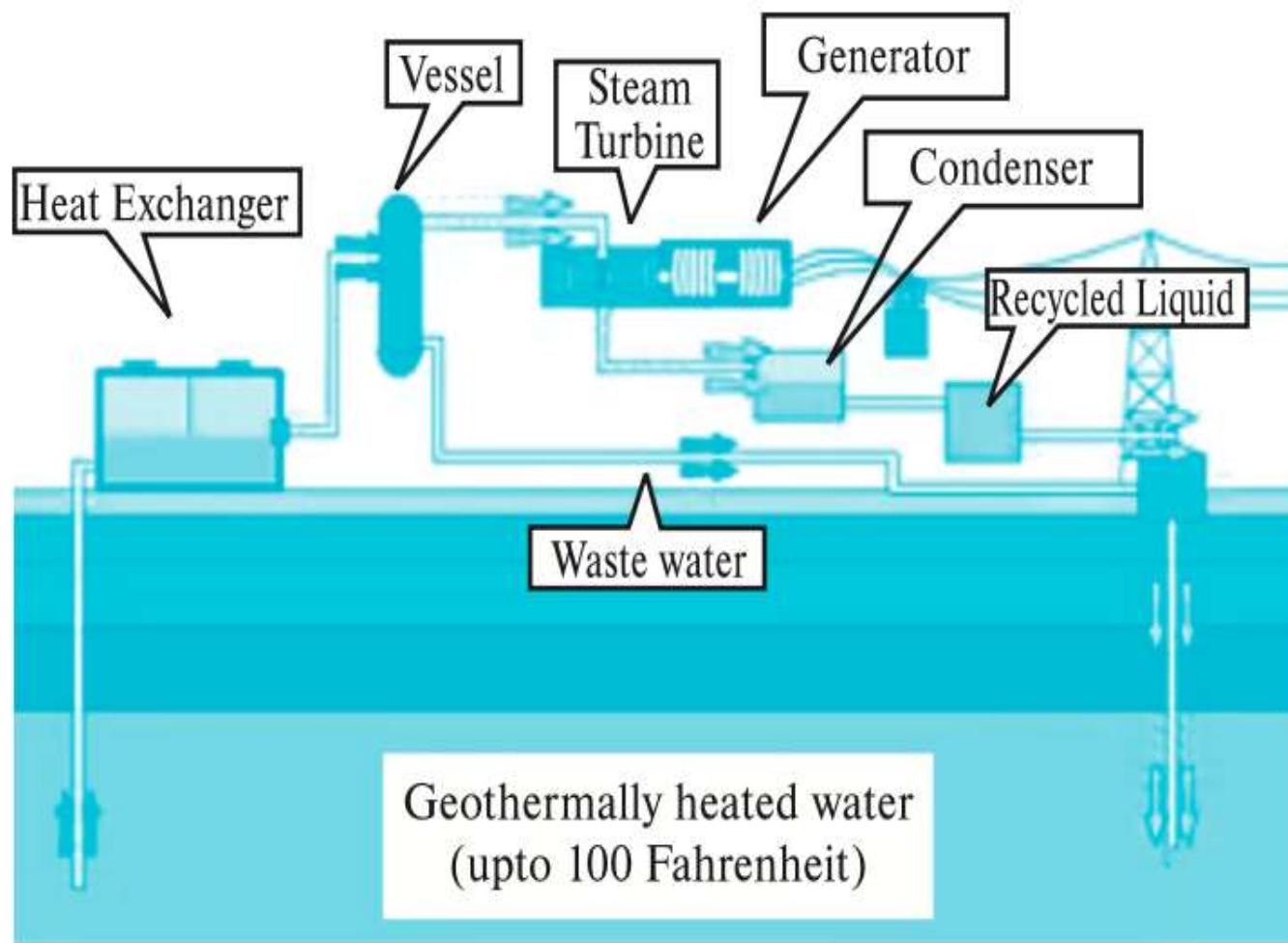


Fig. 3.7 Binary Cycle Power Plant System

- According to India Energy Portal, **India has a geothermal potential of 10,000 megawatts.** The Tattapani (Himachal Pradesh) geothermal field is the most promising geothermal resource in central India. More than 300 sites of geothermal energy sources are identified in India.
- There are seven geothermal provinces in India – the Himalayan, West Coast, Cambay, Son-Narmada-Tapi (Sonata), Godavari and Mahanadi.

OCEAN ENERGY

70 percent of Earth's surface is covered by ocean and hence they are the world's largest solar collectors.

Ocean is also became a source of energy generation in modern prospective.

Thermal energy from the Sun's heat and mechanical energy from the tides and waves are the reason of energy produced by ocean.

There are three forms of electricity generations from sea:

1. Tidal Energy
2. Wave Energy
3. Ocean Thermal Energy

1. Tidal Energy:

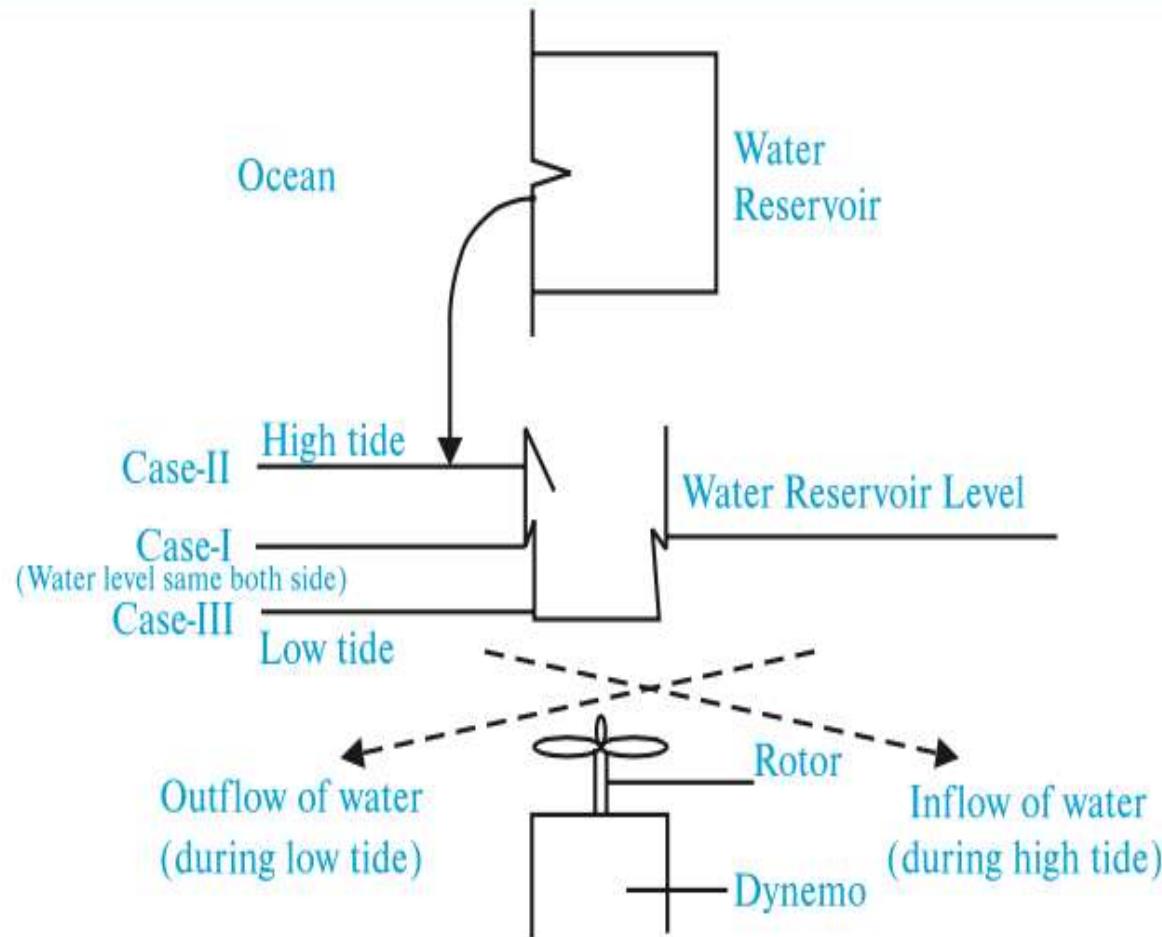


Fig. 3.8 Mechanism of Tidal Energy

2. Wave Energy:

In this type of ocean energy generation, turbine installed inside the ocean and they will move during the effect of ocean current.

This mechanical energy of turbine will convert into electricity with the help of dynamo.

3. Ocean Thermal Energy

The surface water of ocean is heated more by Sun's heat, than the deep ocean water. The temperature difference thus created results in thermal energy.

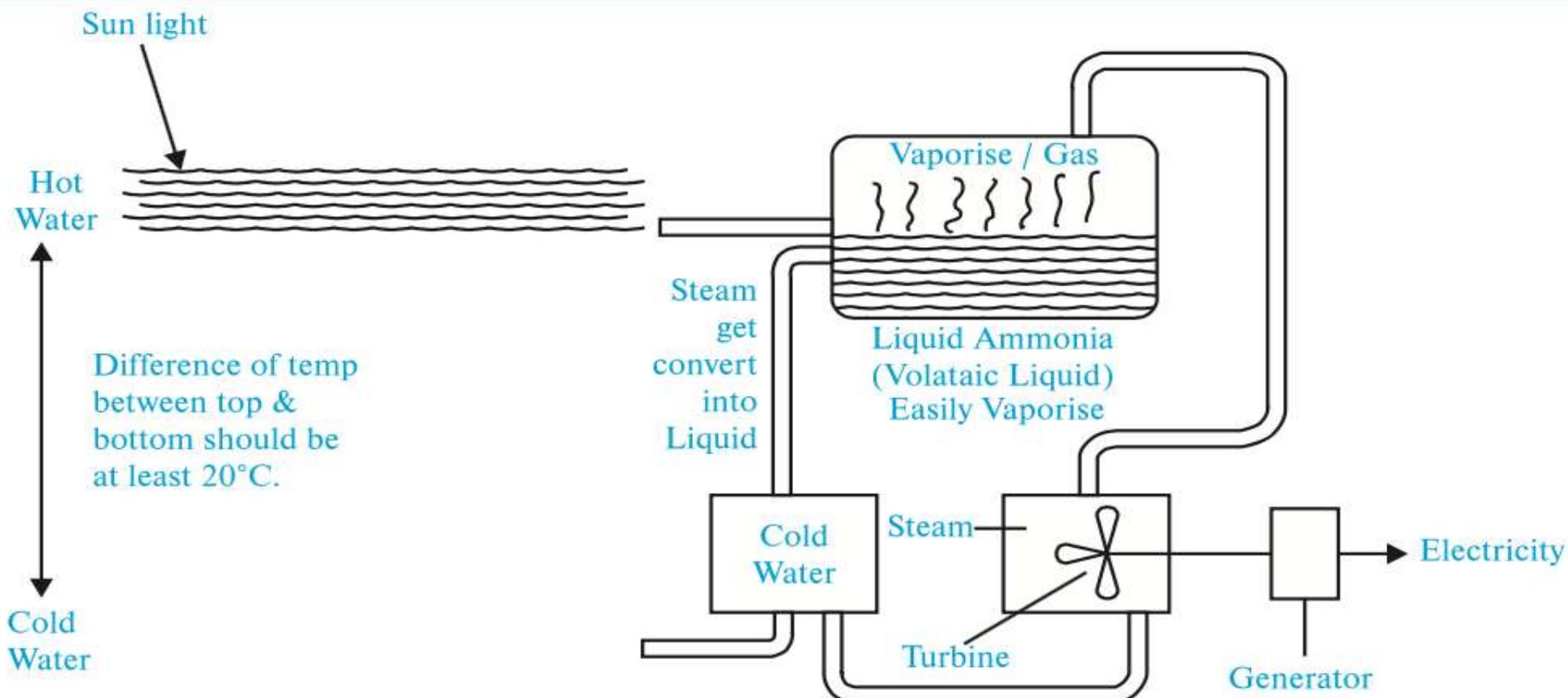
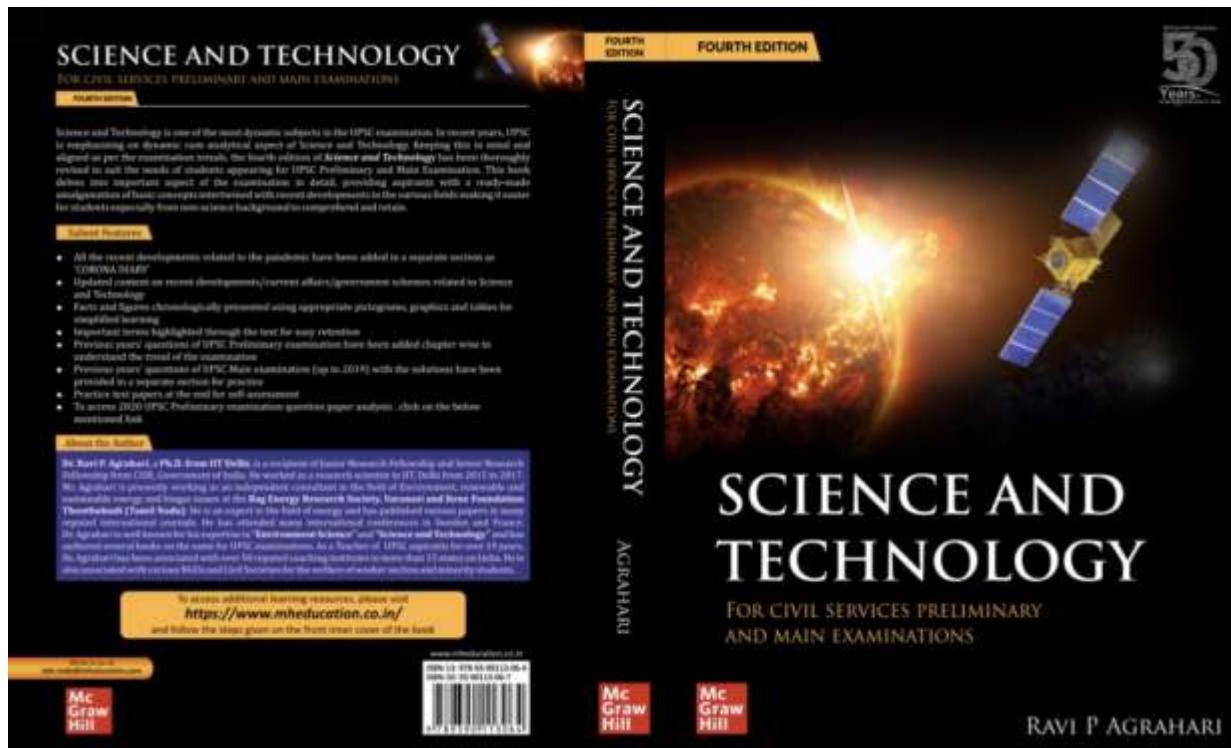


Fig. 3.9 Ocean Thermal Energy System

Potential of Tidal Energy in India

- The **Gulf of Cambay and the Gulf of Kachchh on the west coast**, maximum tidal range of 11 metres and 8 metres and an average tidal range of 6.77 metres and 5.23 metres respectively, are the **most attractive locations in India**.
- Even the **Ganges Delta in the Sunderbans in West Bengal offers good locations for small-scale**

THANK YOU



Dr. Ravi P. Agrahari