

Presentation
on
TIDAL POWER

BACHELOR OF TECHNOLOGY IN CHEMICAL ENGINEERING

Sources of Energy

- Non-Renewable Sources of Energy

Those sources of energy which have accumulated in nature over a very, very long time and cannot be quickly replaced when exhausted are called non-renewable sources of energy.

- Renewable Sources of Energy

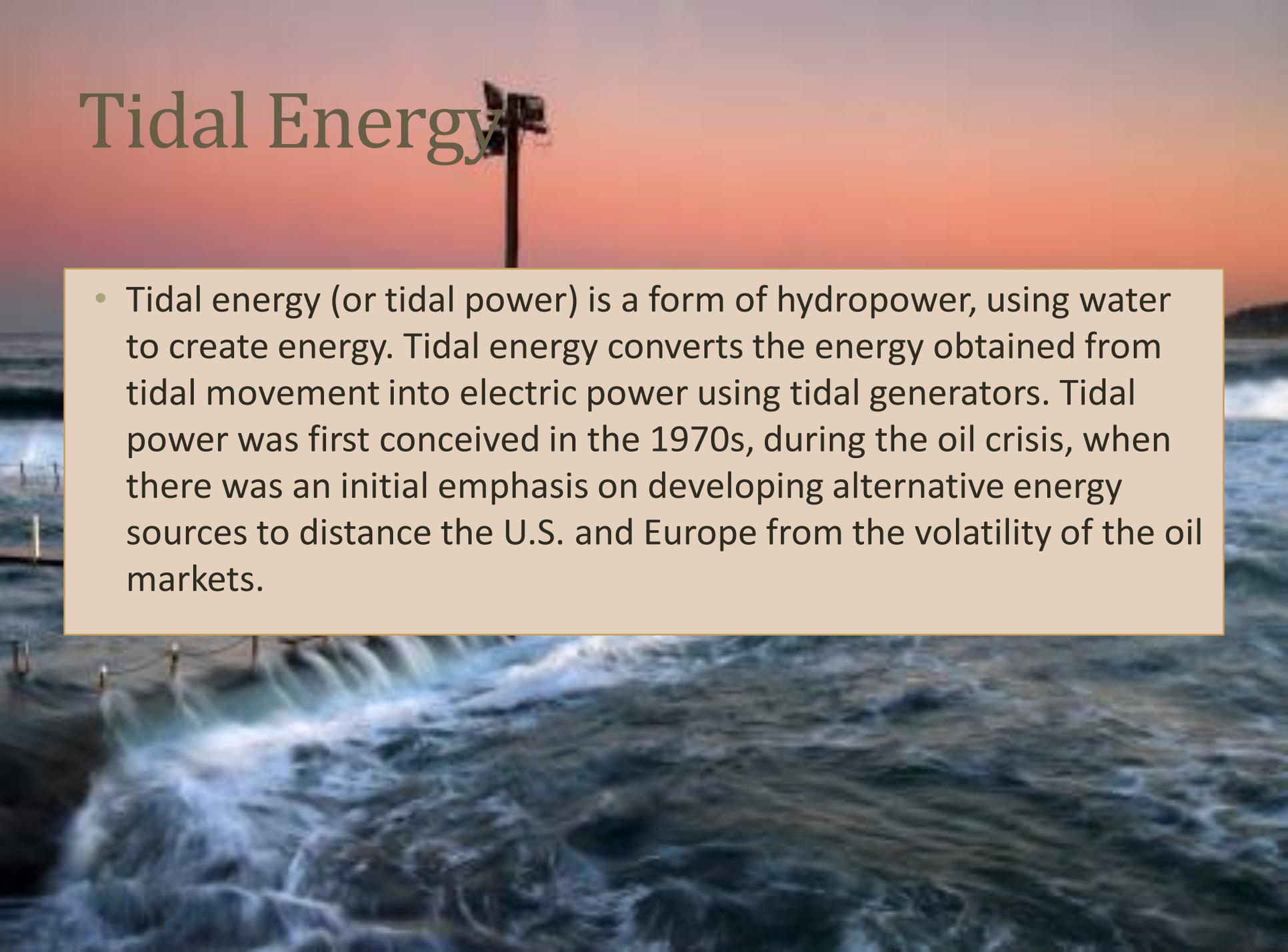
Those sources of energy which are being produced continuously in nature and are inexhaustible, are called renewable sources of energy.

Energy from the sea

The energy from the sea can be obtained mainly in three forms:

1. Tidal energy
2. Wave energy, and
3. Ocean thermal energy

Tidal Energy

The background of the slide features a photograph of a tidal turbine in the ocean. The turbine is a dark, vertical structure with a horizontal nacelle at the top, partially obscured by the large 'Tidal Energy' text. The sky is a gradient of orange and red, suggesting a sunset or sunrise. The water in the foreground is dark blue with white foam from the turbine's blades.

- Tidal energy (or tidal power) is a form of hydropower, using water to create energy. Tidal energy converts the energy obtained from tidal movement into electric power using tidal generators. Tidal power was first conceived in the 1970s, during the oil crisis, when there was an initial emphasis on developing alternative energy sources to distance the U.S. and Europe from the volatility of the oil markets.

Wave Energy

- Wave power is the capture of energy of wind waves to do useful work – for example, electricity generation, water desalination, or pumping water. A machine that exploits wave power is a wave energy converter.
- Wave power is distinct from tidal power, which captures the energy of the current caused by the gravitational pull of the Sun and Moon.
- Waves and tides are also distinct from ocean currents which are caused by other forces including breaking waves, wind and differences in temperature and salinity.

Ocean Thermal Energy

- Ocean thermal energy conversion uses the temperature difference between cooler deep and warmer shallow or surface seawaters to run a heat engine and produce useful work, usually in the form of electricity.
- OTEC can operate with a very high capacity factor and so can operate in base load mode.

The Cause of Tides

- Tides refer to the rise and fall of our oceans' surfaces. It is caused by the attractive forces of the Moon and Sun's gravitational fields as well as the centrifugal force due to the Earth's spin.
- The Moon, although much smaller than the Sun, is much closer. Now, gravitational forces decrease rapidly as the distance between two masses widen. Thus, the Moon's gravity has a larger effect on tides than the Sun. In fact, the Sun's effect is only about half that of the Moon's.



Moon

Diameter: 3476 km

Ratio : 1

Example : sago

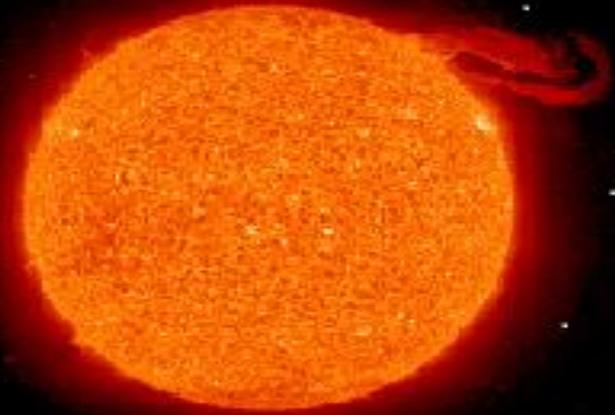


Earth

12756 km

4

glass marble



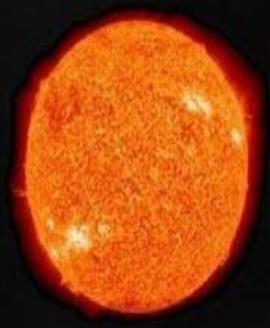
Sun

1392000 km

400

basketball

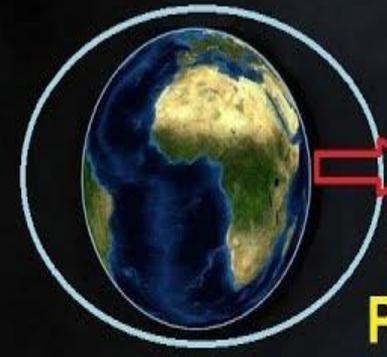
SUN



Pull of Sun



EARTH



FULL MOON



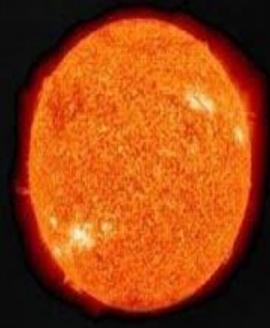
Pull of Moon



SPRING TIDES

Tidal Bulge

SUN



Pull of Sun

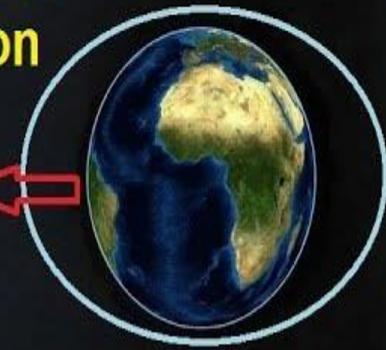


Pull of Moon



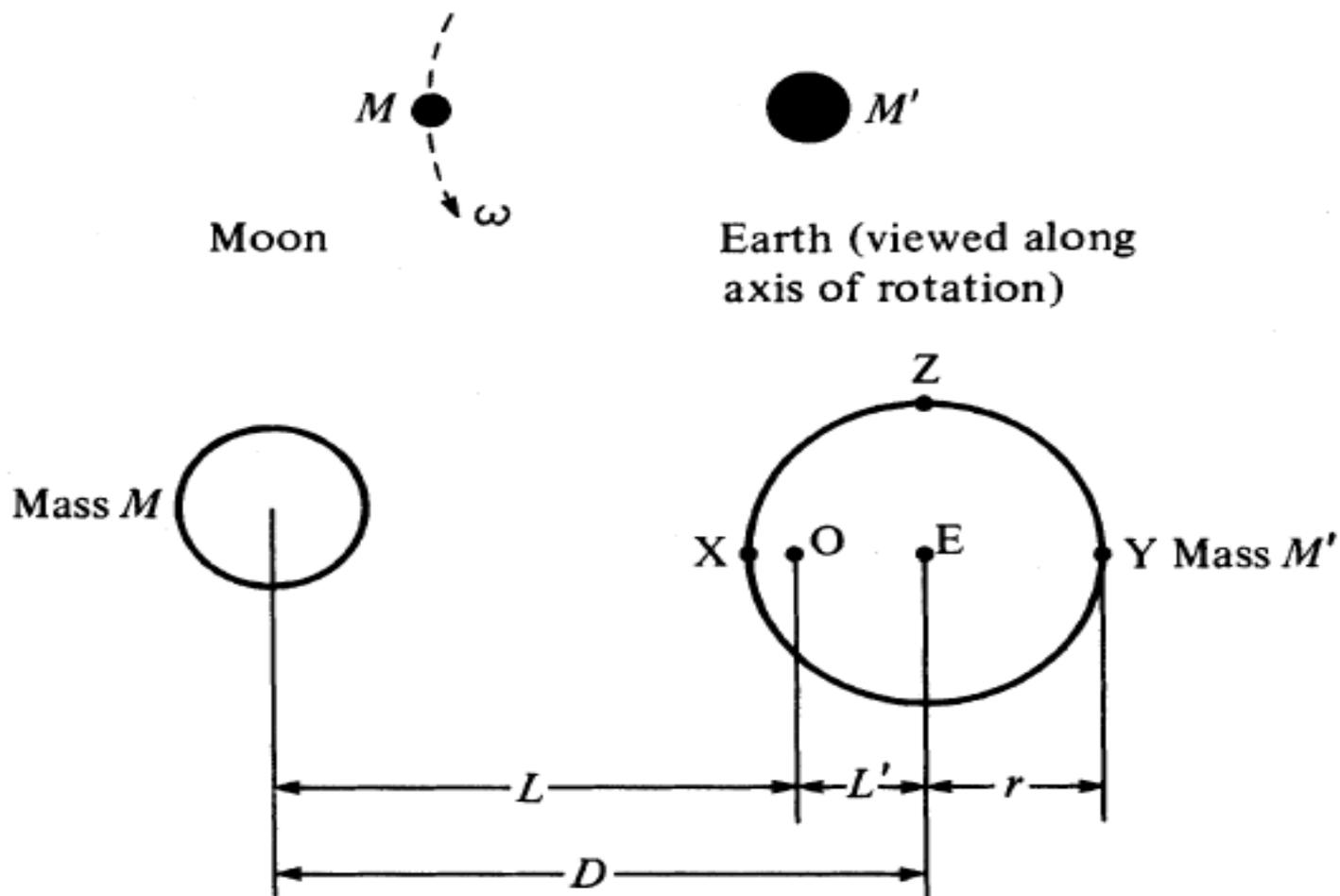
NEW MOON

EARTH



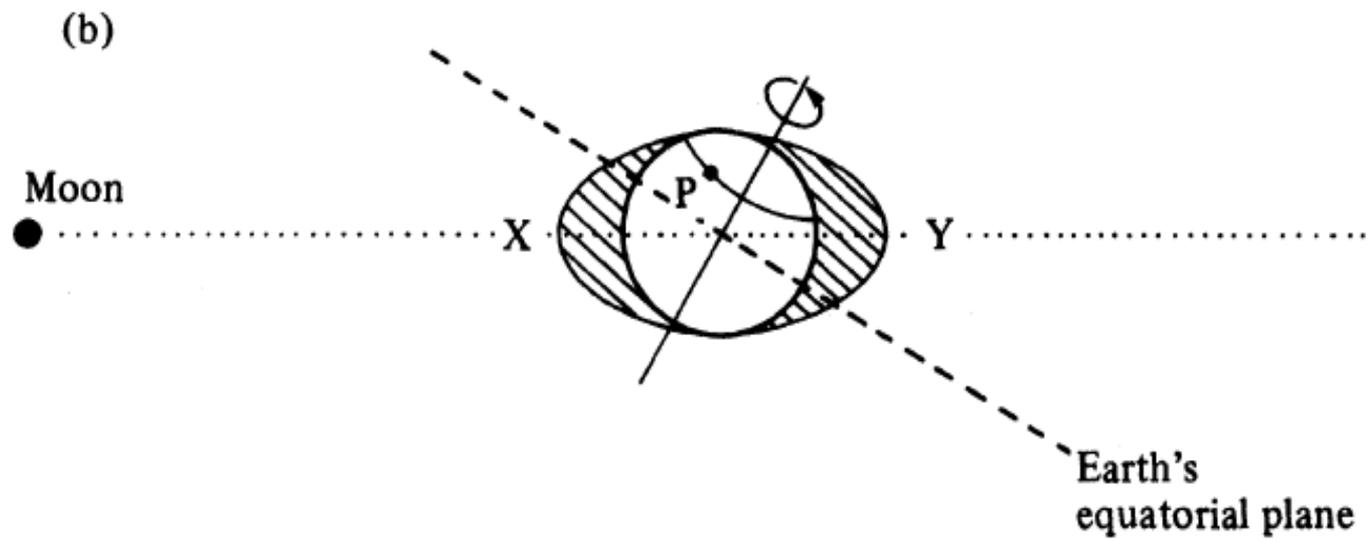
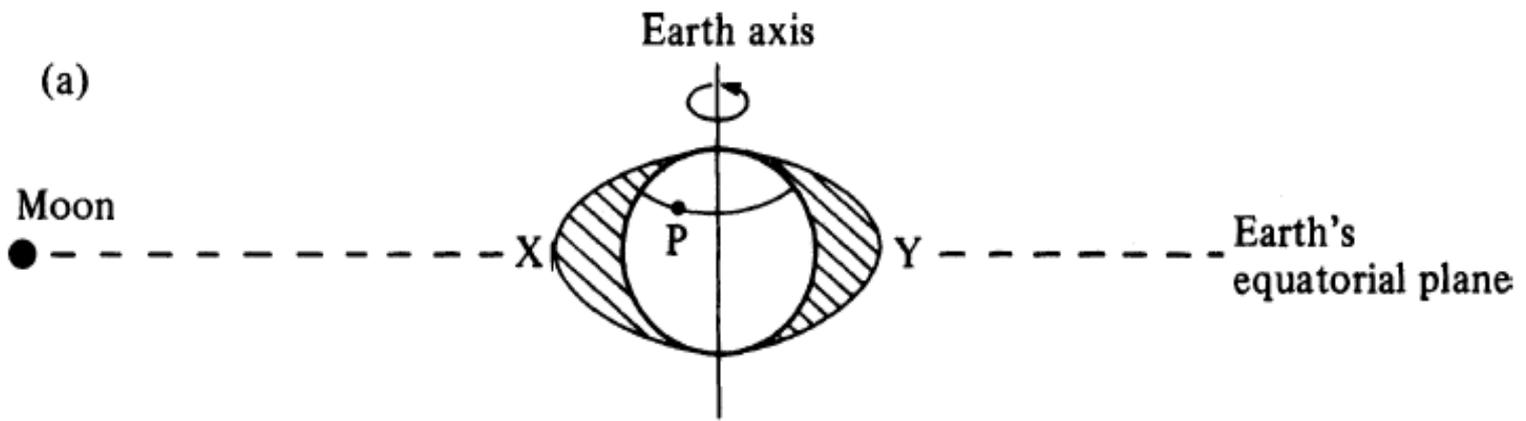
The lunar induced tide

- The Moon and Earth revolve about each other in space but since the mass of the Earth is nearly hundred times greater than the Moon's mass, the Moon's motion is more apparent. The centre of revolution is at O, such that
- $ML = M'L'$
- $L' = MD/M' + M$
- $L' = 4670\text{km}$



Moon: $M = 7.35 \times 10^{22}$ kg
 Earth: $M' = 598 \times 10^{22}$ kg

$D = L + L' = 384 \times 10^6$ m
 $r = 6.38 \times 10^6$ m



Generation of Tidal energy

- Tidal power is taken from the Earth's oceanic tides. Tidal forces are periodic variations in gravitational attraction exerted by celestial bodies.
- Due to the strong attraction to the oceans, a bulge in the water level is created, causing a temporary increase in sea level.

Tidal stream Generator

- Tidal stream generators make use of the kinetic energy of moving water to power turbines, in a similar way to wind turbines that use wind to power turbines.
- Some tidal generators can be built into the structures of existing bridges or are entirely submersed, thus avoiding concerns over impact on the natural landscape.

Tidal barrage

- Tidal barrages make use of the potential energy in the difference in height (or hydraulic head) between high and low tides.
- When using tidal barrages to generate power, the potential energy from a tide is seized through strategic placement of specialized dams.
- When the sea level rises and the tide begins to come in, the temporary increase in tidal power is channeled into a large basin behind the dam, holding a large amount of potential energy.

Dynamic Tidal power

- Dynamic tidal power (or DTP) is an untried but promising technology that would exploit an interaction between potential and kinetic energies in tidal flows.
- Tidal phase differences are introduced across the dam, leading to a significant water-level differential in shallow coastal seas – featuring strong coast-parallel oscillating tidal currents such as found in the UK, China, and Korea.

Tidal lagoon

- A new tidal energy design option is to construct circular retaining walls embedded with turbines that can capture the potential energy of tides.
- The created reservoirs are similar to those of tidal barrages, except that the location is artificial and does not contain a pre-existing ecosystem.
- The lagoons can also be in double (or triple) format without pumping or with pumping that will flatten out the power output.

Corrosion

- Salt water causes corrosion in metal parts. It can be difficult to maintain tidal stream generators due to their size and depth in the water.
- The use of corrosion-resistant materials such as stainless steels, high-nickel alloys, copper-nickel alloys, nickel-copper alloys and titanium can greatly reduce, or eliminate, corrosion damage.

Cost

- Tidal Energy has an expensive initial cost which may be one of the reasons tidal energy is not a popular source of renewable energy.
- It is projected that tidal power will be commercially profitable within 2020 with better technology and larger scales.
- Tidal Energy is however still very early in the research process and the ability to reduce the price of tidal energy can be an option. The cost effectiveness depends on each site tidal generators are being placed.

Environmental impacts of Tidal Energy

- The main environmental concerns with tidal energy are from the turbine blades striking or entangling marine organisms, as higher speed flowing water increases the risk of organisms being pulled near or through these devices.
- As with all offshore renewable energies , there is also a concern about how the creation of electromagnetic fields and acoustic outputs may affect marine organisms.

How Tidal Energy compares with other Renewables

- Tidal stream generators draw energy from water currents in much the same way as wind turbines draw energy from air currents.
- While the initial cost of building tidal energy plants is high, tidal energy power plants are expected to run for a very long time, which make them more cost-effective in the long run.

Advantages

- It is an inexhaustible source of energy.
- Tidal energy is environment friendly energy and doesn't produce greenhouse gases.
- As 71% of Earth's surface is covered by water, there is scope to generate this energy on large scale.
- We can predict the rise and fall of tides as they follow cyclic fashion.
- Efficiency of tidal power is far greater as compared to coal, solar or wind energy. Its efficiency is around 80%.
- Although cost of construction of tidal power is high but maintenance costs are relatively low.

Disadvantages

- Cost of construction of tidal power plants is high.
- There are very few ideal locations for construction of plant and they too are localized to coastal regions only.
- Intensity of sea waves is unpredictable and there can be damage to power generation units.
- Influences aquatic life adversely and can disrupt migration of fish.
- The actual generation is for a short period of time. The tides only happen twice a day so electricity can be produced only for that time.
- Frozen sea, low or weak tides, straight shorelines, low tidal rise or fall are some of the obstructions.

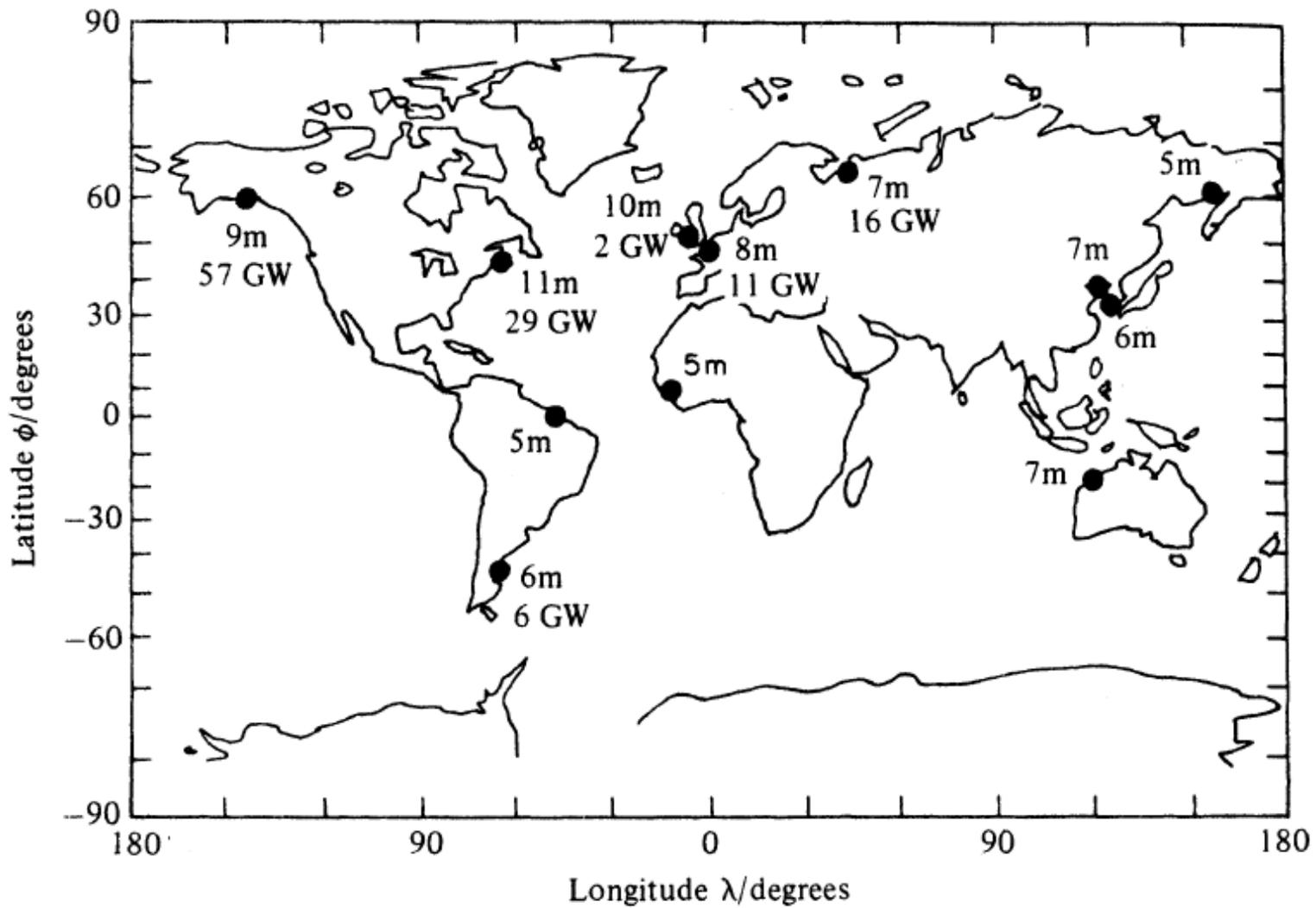
Uses

- **Tidal Electricity-** Like other forms of Energy, the main usage of Tidal Energy is in the generation of Electricity. Tidal Energy is being used in France to generate 240MW of Tidal Electricity at very low costs.
- **Grain Mills-** Tidal Energy has been used for hundreds of years. Just like Wind Mills, Tidal Energy was used for the mechanical crushing of grains in Grains Mills.
- **Energy Storage-** Tidal Energy can also be used as a store of Energy. Like many of the hydroelectric dams which can be used a large Energy Storage, so Tidal Barrages with their reservoirs can be modified to store energy.

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- **Provide Protection to Coast in High Storms-** Tidal Barrages can prevent Damage to the Coast during High Storms and also provide an easy transport method between the 2 arms of a Bay or an Estuary on which it is built.

World Range Power Sites

- The total dissipation of energy by water tides in the Earth is estimated to be 3000GW, including no more than about 1000GW dissipated in shallow sea areas accessible for large civil engineering works.
- They have a combined total potential of about 120GW.
- This is about 12% of near-shoreline potential and 10% of the total world hydropower (river) potential.



Tidal Energy in India

- According to the estimates of the **Indian** government, the country has a potential of 8,000 MW of **tidal energy**.
- This includes about 7,000 MW in the Gulf of Cambay in Gujarat, 1,200 MW in the Gulf of Kutch and 100 MW in the Gangetic delta in the Sunderbans region of West Bengal.

Conclusion

- Tidal energy is a kind of renewable energy with large potential. It has many advantages over solar and wind energy.
- For example, the availability of tidal energy is highly predictable and not subject to the impact of weather condition. The energy density of tides is also higher than solar and wind energy.