Unit 5:- Other Alternate Sources

Tidal & Wave Energy

Syllabus…Unit 5

- **Other Alternate Sources:** Ocean Thermal Energy Conversion, Geothermal, Tidal, Wave Energy, MHD, Fuel Cells, environmental issues of energy services.

Books …

- Gilbert M. Masters, *Renewable and Efficient Electrical Power Systems*, Wiley - IEEE

Press, August 2004.

- Godfrey Boyle, *Renewable Energy*, Third edition, Oxford University Press, 2012.
- Chetan Singh Solanki, *Solar Photovoltaics-Fundamentals, Technologies and Applications*, PHI Third Edition, 2015.

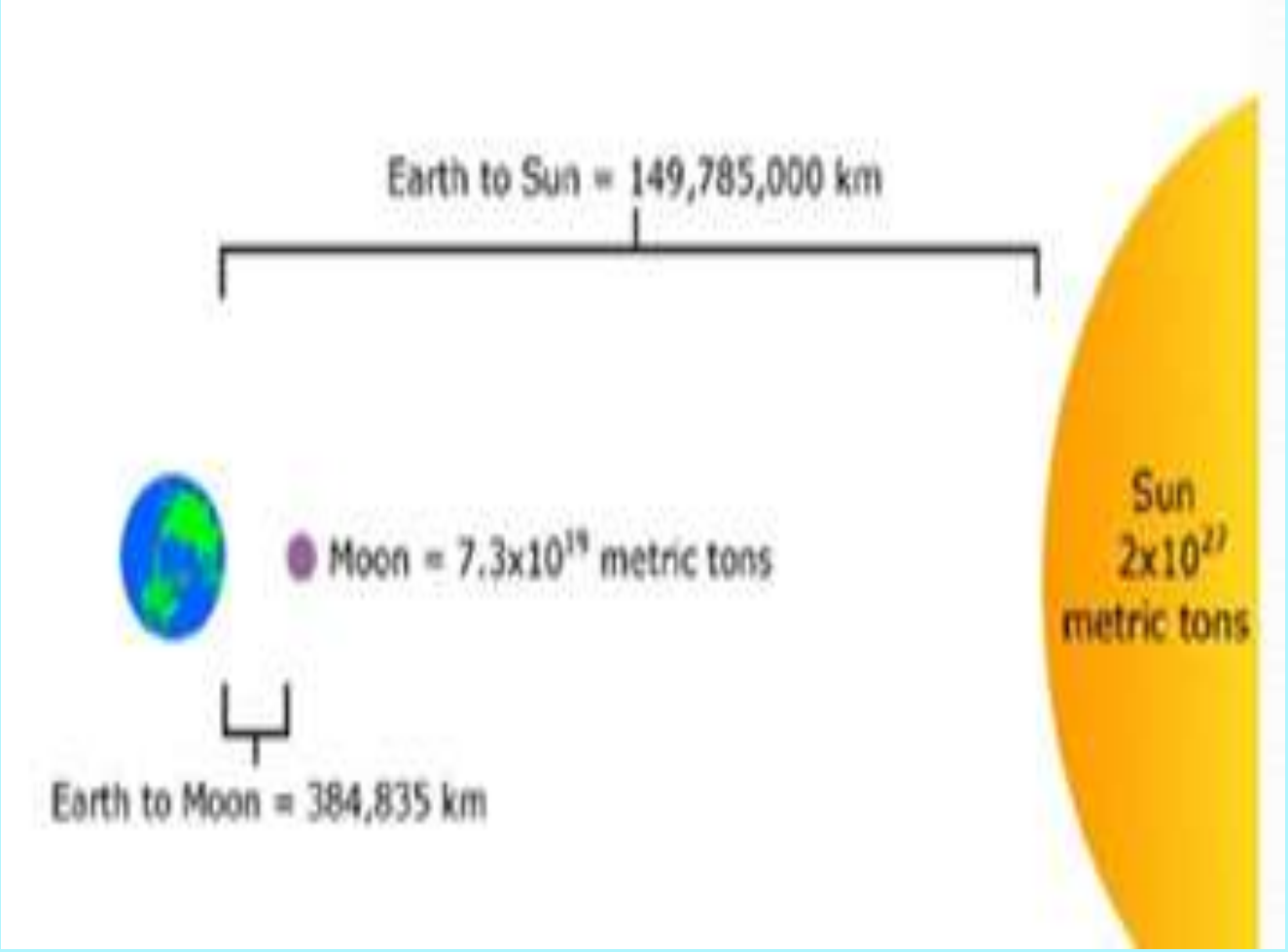
Supplementary Reading:

- D.P.Kothari, K.C.Singal, Rakesh Rajan, *Renewable Energy Sources and Emerging Technologies*, PHI Second Edition, 2011.

Lecture 3 Tidal & Wave Energy

- Tidal Force

Tidal Force



Tides are the rise and fall of sea levels caused by the combined effects of the gravitational f orces exerted by the Moon and the Sun, and the rotation of the Earth.

Tidal Force

$$\text{Tide-Generating Force} = \propto \frac{\text{Mass}}{(\text{Distance})^3}$$

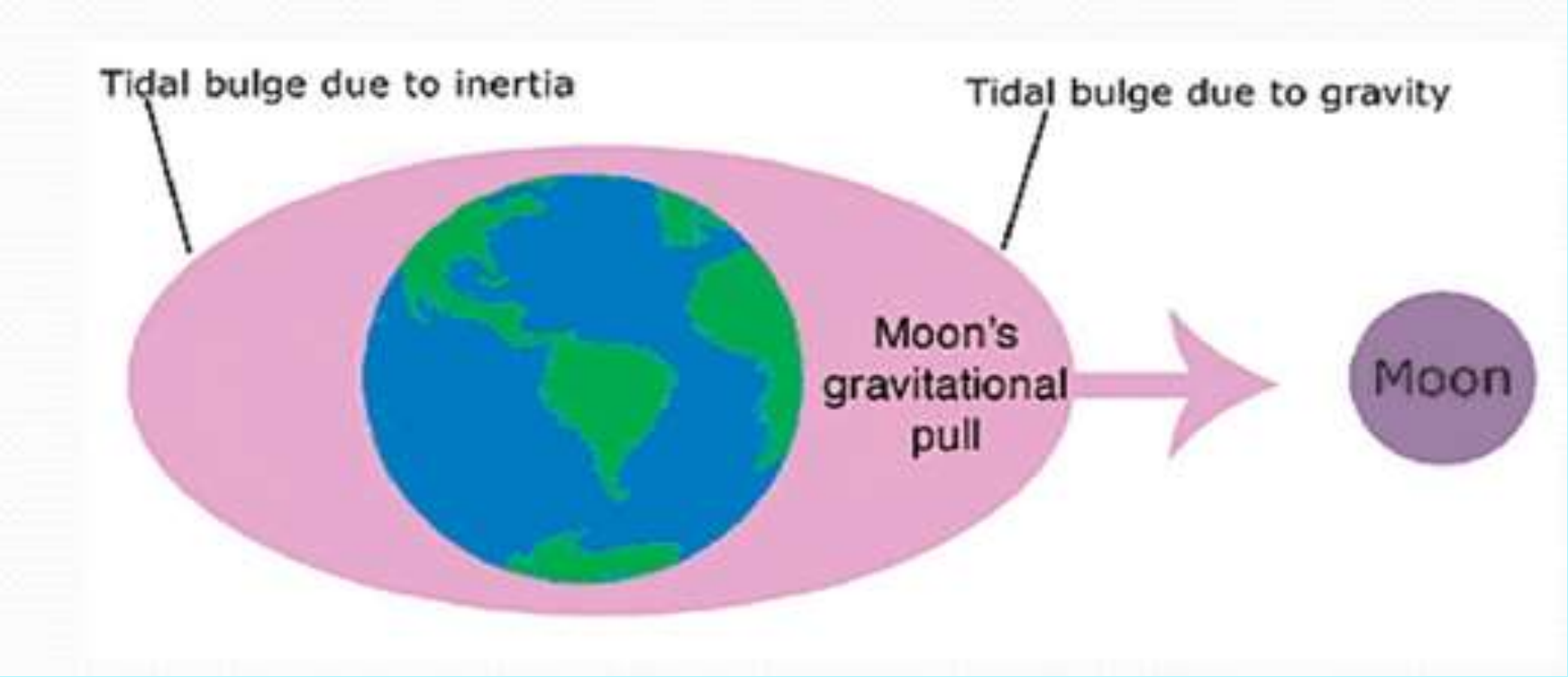
$$\text{Tide-Generating Force of the Sun} = \propto \frac{\text{Sun's Mass}}{(\text{Sun's Distance to Earth})^3}$$

*NOTE: The sun has 27 million times more mass than the moon and is 390 times farther away from the earth than the moon.

$(390)^3 = 59{,}000{,}000$ So... $\frac{27 \text{ million}}{59 \text{ million}} = 0.46$ or 46%

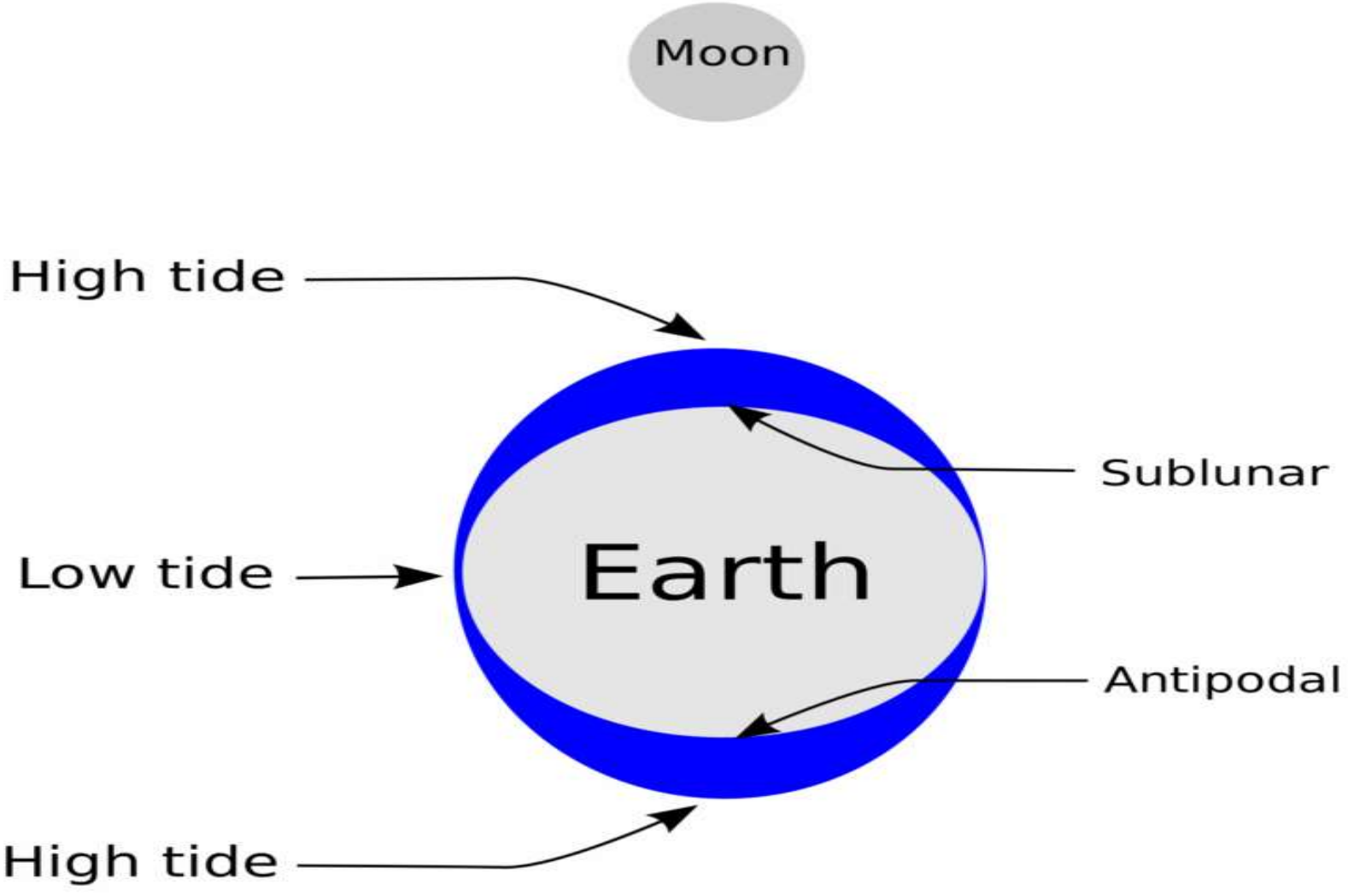
The Sun has only 46% of the tide generating force that of the Moon.

Tidal Force: Gravity Inertia & Bulges

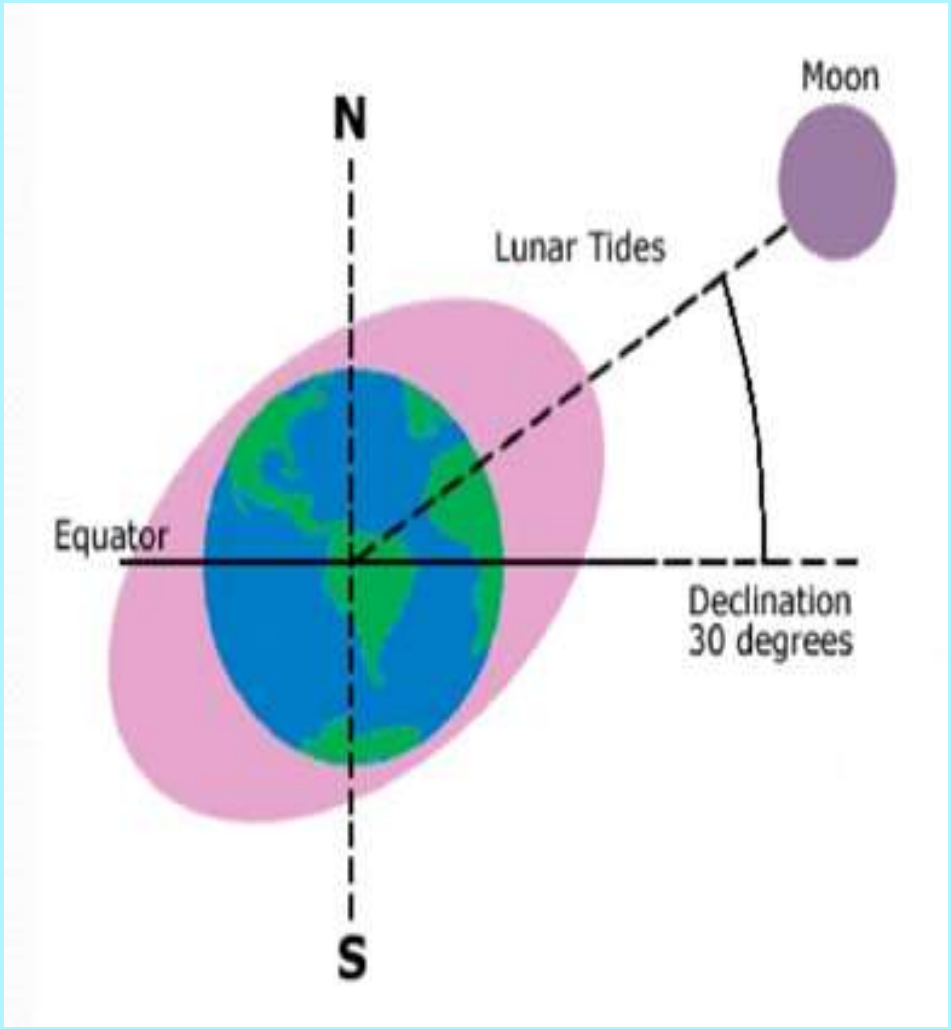


Tides are commonly *semi-diurnal* (two high waters and two low waters each day), or *diurnal* (one tidal cycle per day).

Tidal Force: Gravity Inertia & Bulges

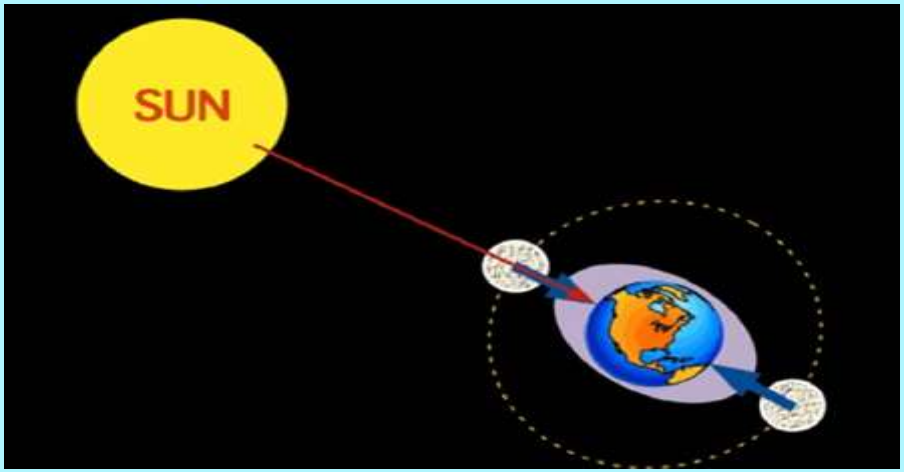


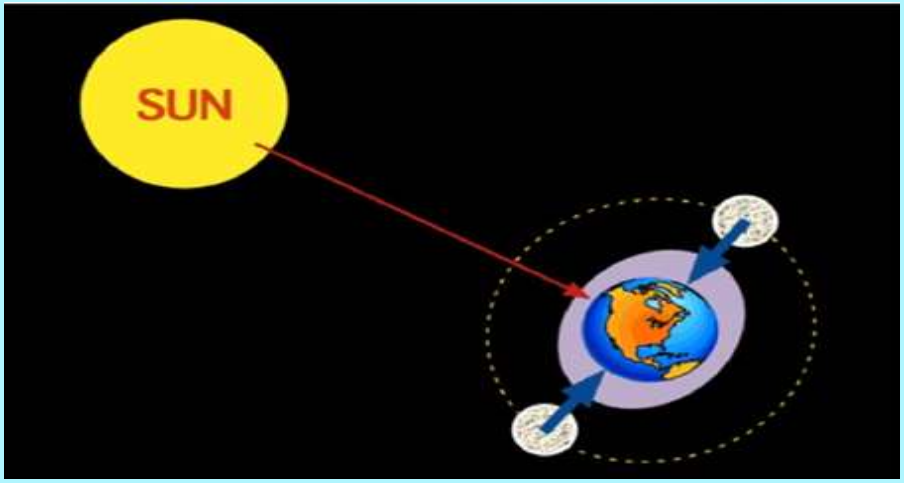
Effect of Angle on Tides



The two high waters on a given day are typically not the same height (the daily inequality); these are the *higher high water* and the *lower high water* in tide tables. Similarly, the two low waters each day are the *higher low water* and the *lower low water*. The daily inequality is not consistent and is generally small when the Moon is over the Equator.

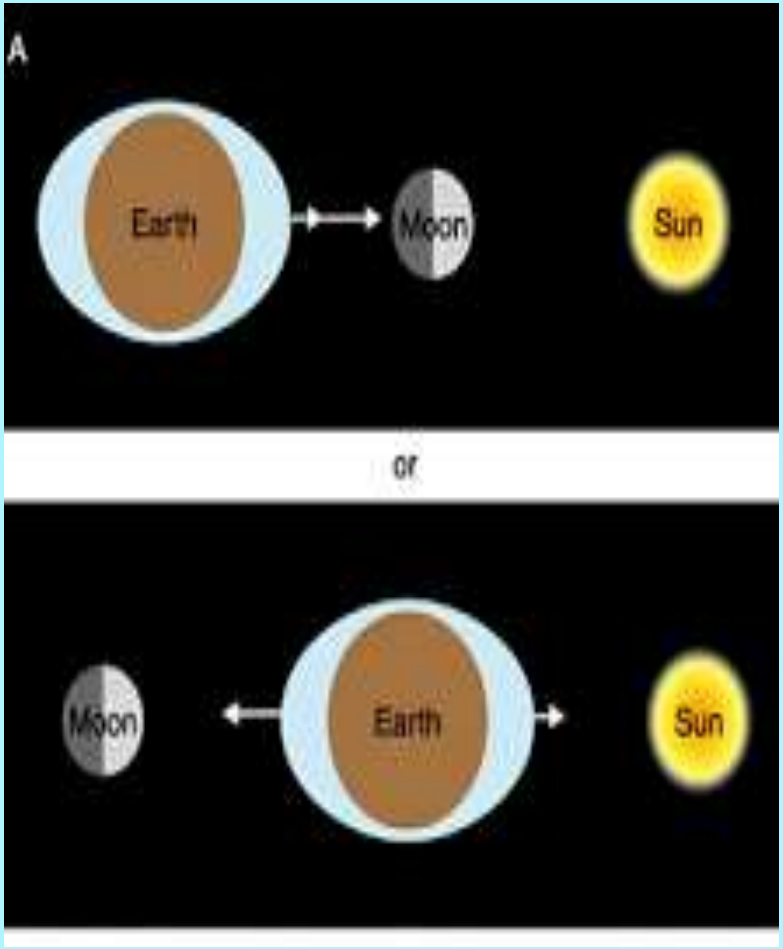
Effect of Angle on Tides

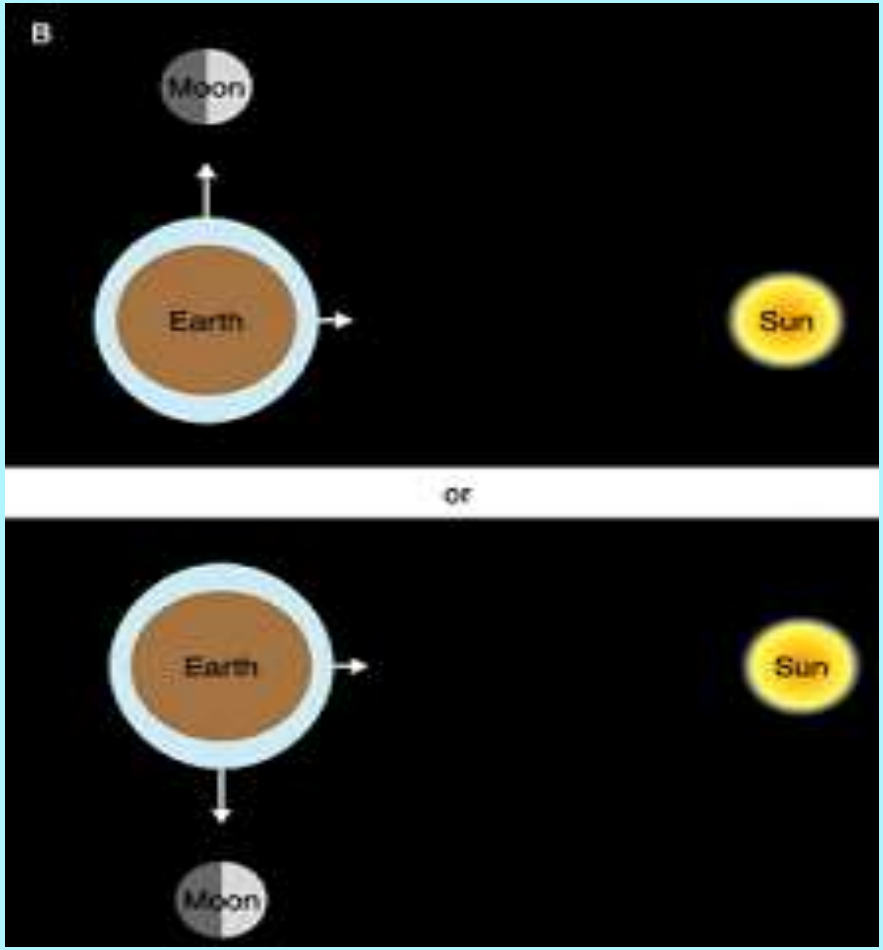




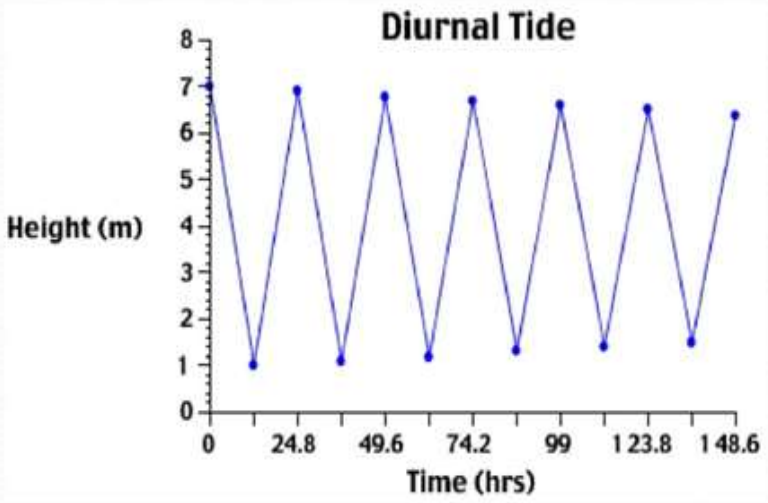
Tide tables can be used for any given locale to find the predicted times and amplitude (or "tidal range"). The predictions are influenced by many factors including the alignment of the Sun and Moon, the phase and amplitude of the tide (pattern of tides in the deep ocean), the Amphidromic systems of the oceans, and the shape of the coastline and near-shore bathymetry.

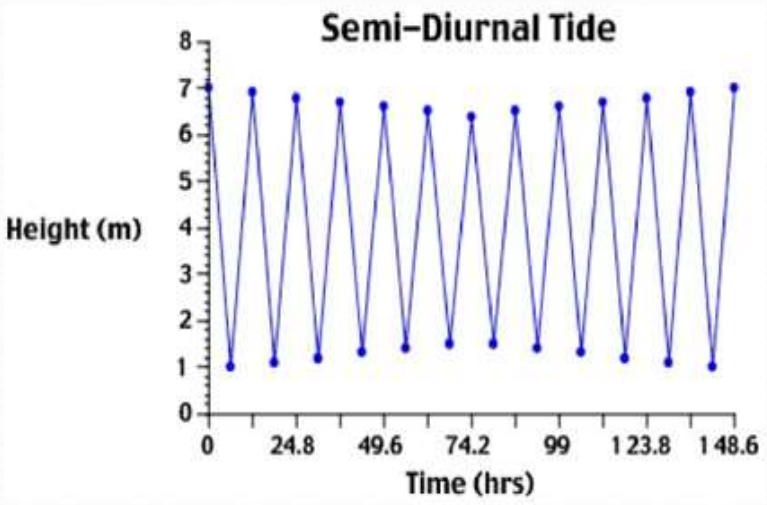
Types Of Sea Tides

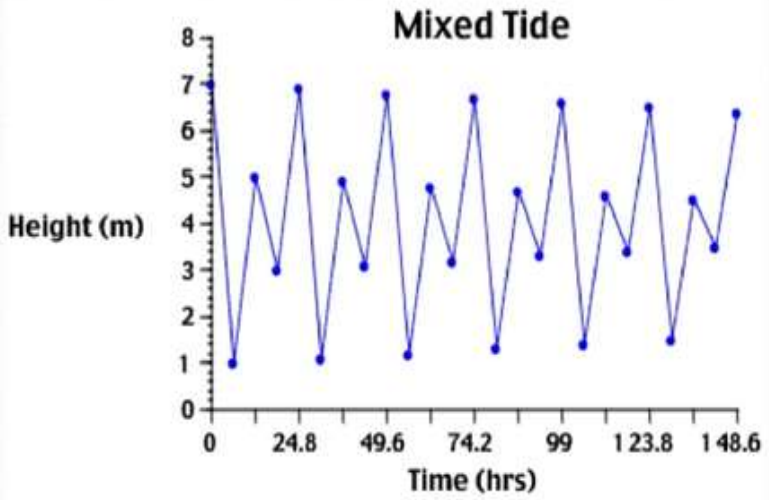




Types Of Sea Tides







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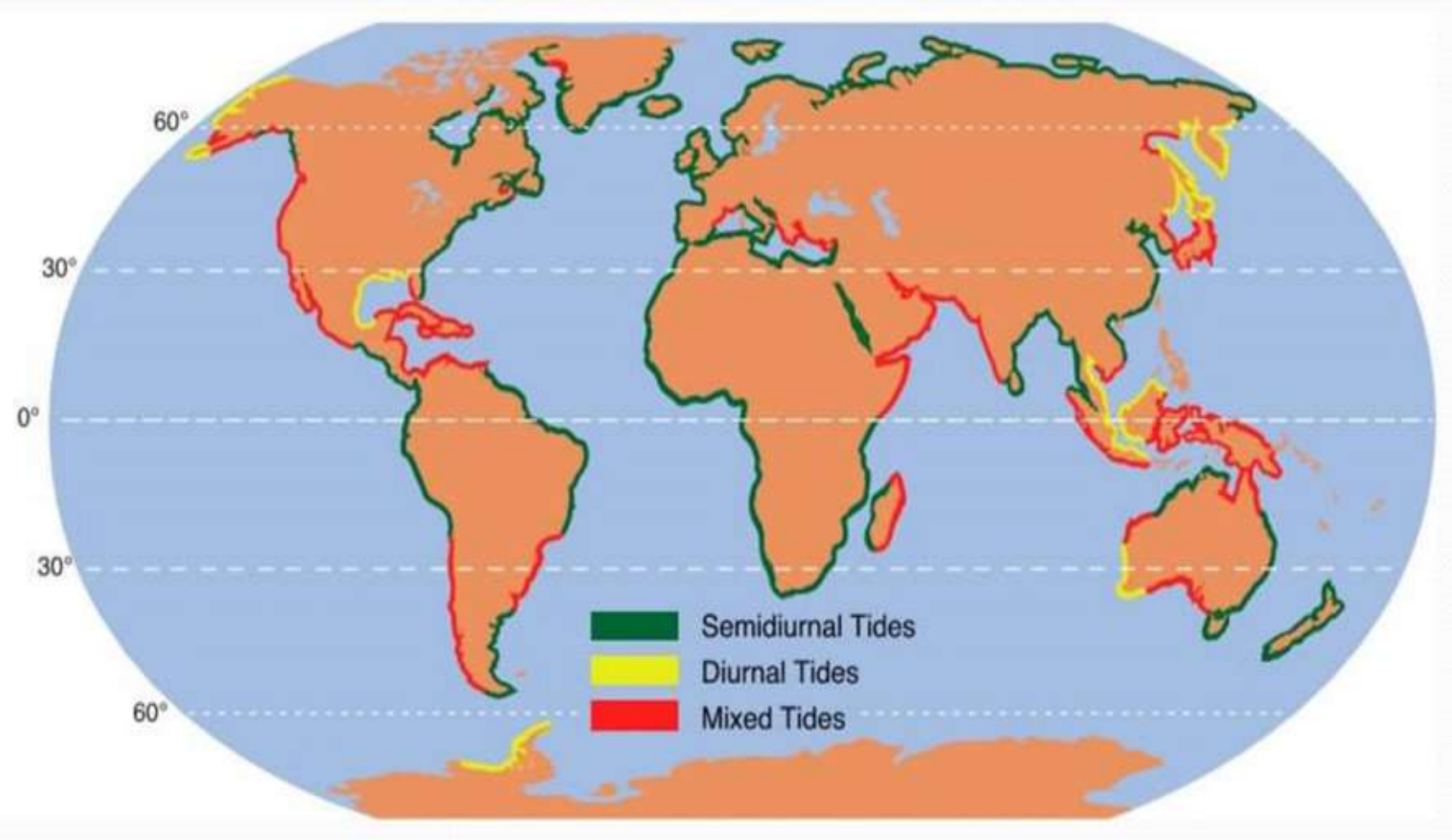
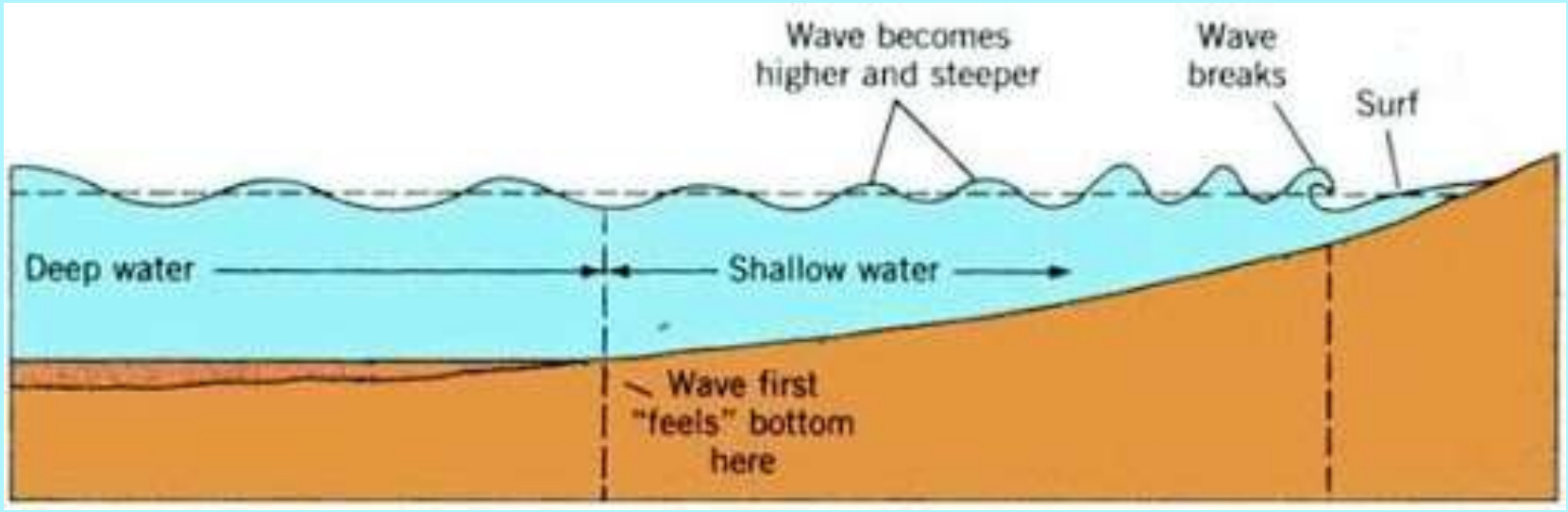
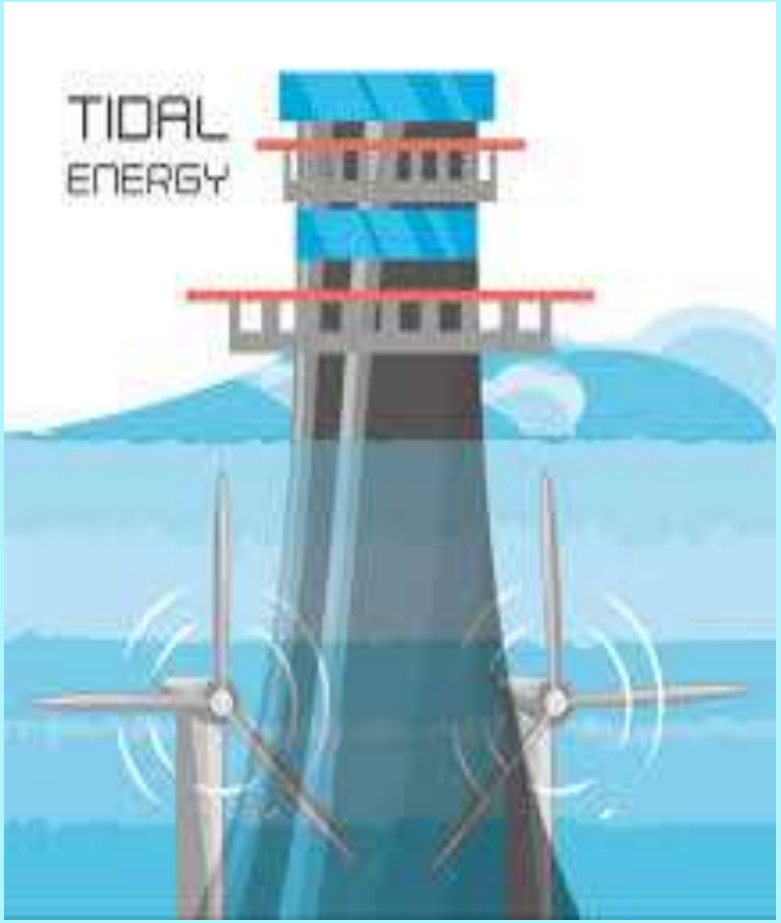


Parameters Affecting Tides

- Shape of shore line (wide continental margin)
- Shape of bays and estuaries
- Wind
- Pressure

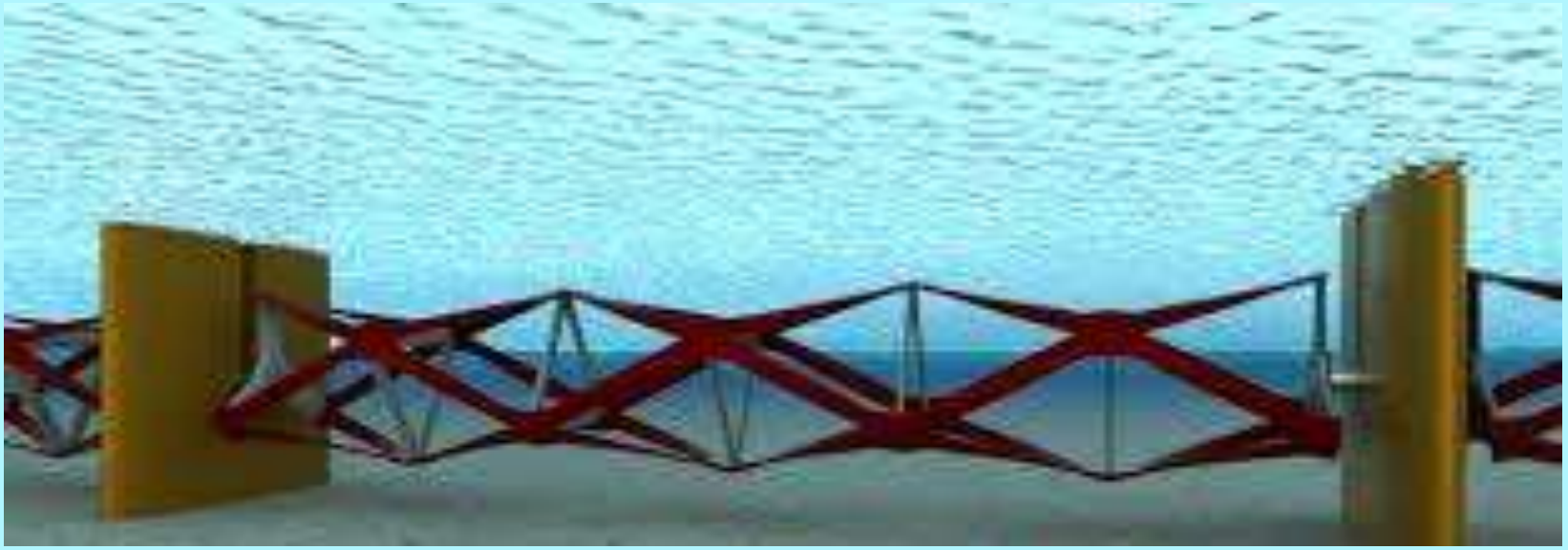


Types of Tidal Power Plants



- Kinetic Energy
  - Tidal Fence
  - Tidal Farms
- Potential Energy: Barrage Type / Basin Type
  - Flood Generation
  - Ebb Generation
  - Two way Generation

Kinetic Energy: Tidal Fence Power Plants



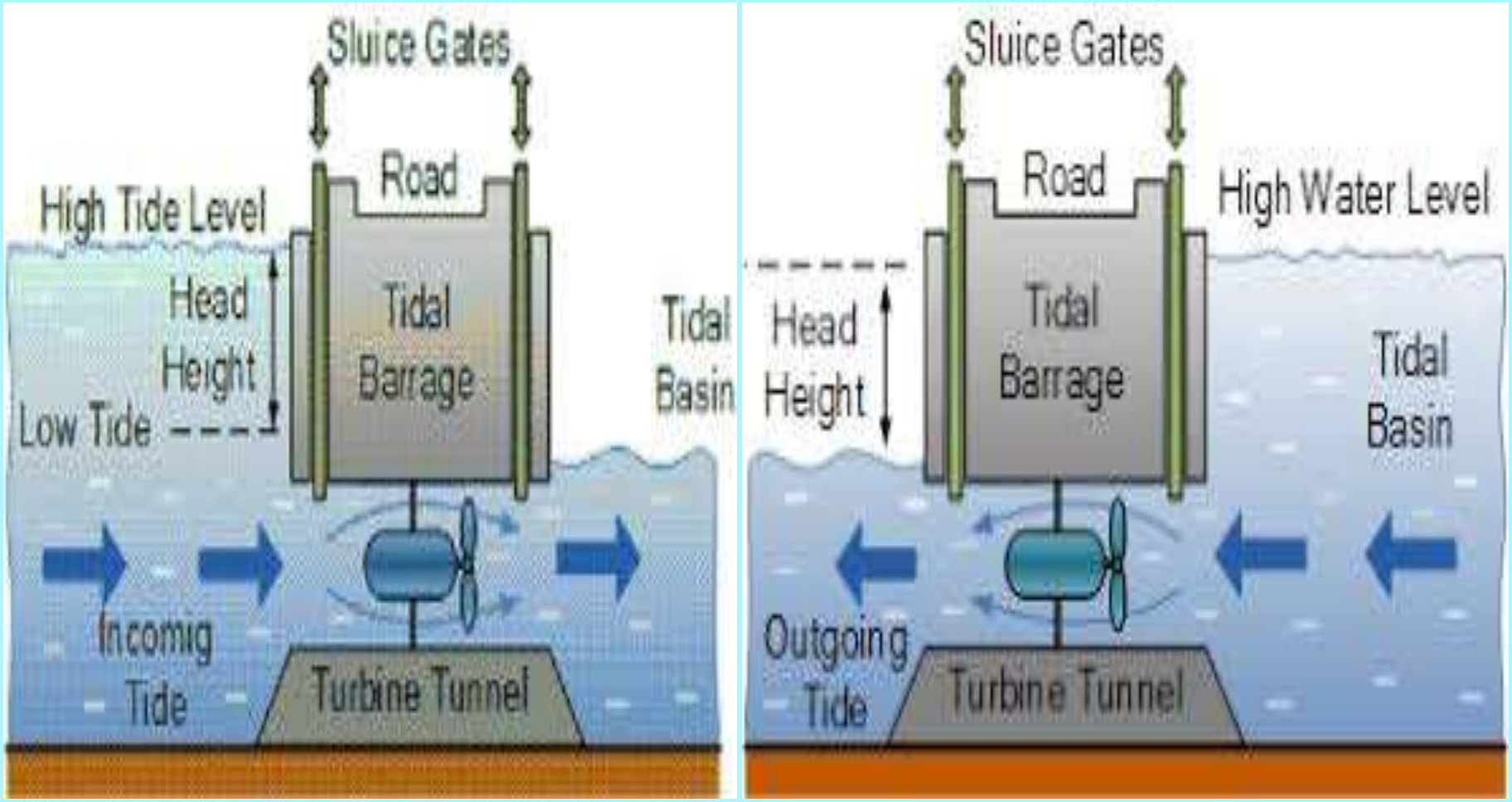
Kinetic Energy: Tidal Farms Power Plants

Potential Energy Tidal Barrage / Basin Type

2. Tidal Barrage

- Uses PE of water
- Uses a dam like structure
- 2 flow directions
- Oldest method

Potential Energy Tidal Barrage / Basin Type



Thank You