Wave energy

- Wave energy is an irregular and oscillating low frequency energy source that can be converted to a 50 Hertz frequency and can then be added to the electric utility grid.
- Waves get their energy from the wind, which comes from solar energy.
- Waves gather, store, and transmit this energy thousands of kilometers with very little loss.
- Though it varies in intensity, it is available twenty four hours a day all round the year.

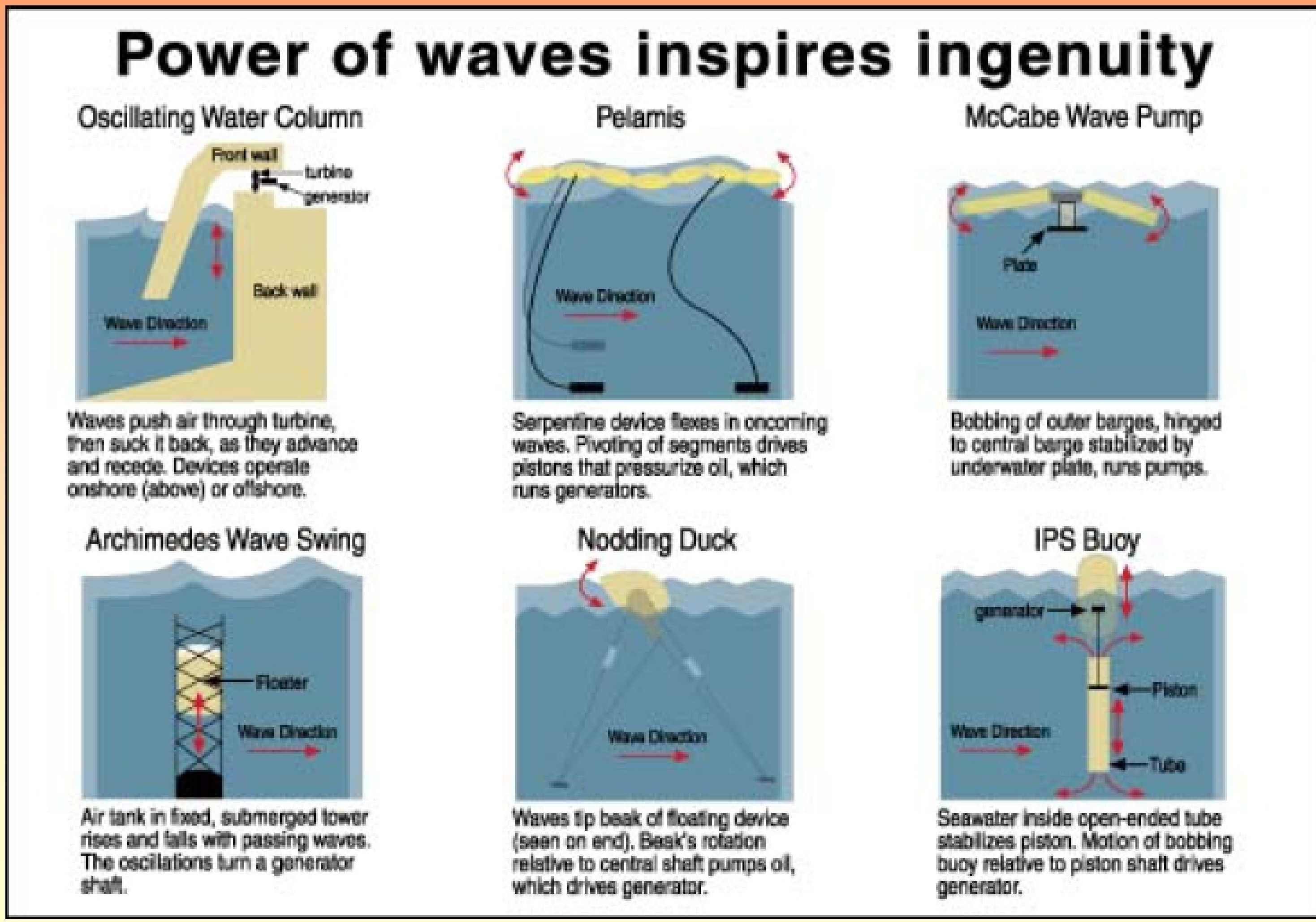
Wave energy-1

- Wave power is renewable, pollution free and environment friendly. Its net potential is better than wind, solar, small hydro or biomass power.
- Wave energy technologies rely on the up-and-down motion of waves to generate electricity.
- There are three basic methods for converting wave energy to electricity.
- **Float or buoy systems** that use the rise and fall of ocean swells to drive hydraulic pumps.
- The object can be mounted to a floating raft or to a device fixed on the ocean bed.
- A series of anchored buoys rise and fall with the wave.
- The movement is used to run an electrical generator to produce electricity which is then transmitted ashore by underwater power cables.

Wave energy-2

- **Oscillating water column devices** in which the in-and-out motion of waves at the shore enters a column and force air to turn a turbine.
- The column fills with water as the wave rises and empties as it descends.
- In the process, air inside the column is compressed and heats up, creating energy.
- This energy is harnessed and sent to shore by electrical cable.
- **Tapered channel** rely on a shore mounted structure to channel and concentrate the waves driving them into an elevated reservoir.
- Water flow out of this reservoir is used to generate electricity using standard hydropower technologies.

Wave energy-3



Estimation Of Power Associated With Waves-3

dv = dx.dy.dz

dx*dy is the volume per unit width of the wave.

Ek = kinetic energy per unit length in X direction.

dEk*dx= K.E of particle of width dx

$= (1/2)mv^2$

$= (1/2).dx.dy.\rho.v^2$

$= (1/2).dx.dy.\rho.(\omega.r)^2$

$dEk=(1/2).dy.\rho.(\omega.r)^2$

$=(1/2).\ \rho.\omega^2.a^2.e^{2y}.dy$

$\int_{-\infty}^{0} dEk =(1/2).\ \rho.\omega^2.a^2.\int_{-\infty}^{0} e^{2y}.dy$

$= \rho*\omega^2*a^2/(4*K)$

Estimation Of Power Associated With Waves-3

$K=2\pi/\lambda$

$\lambda=2\pi g/\omega^2$

$Ek=(1/4).\rho.a^2.g$

$Ep=(1/4).\ \rho.a^2.g$

Total wave energy$=(1/2)^*.\rho.a^2.g$

$E\lambda=(1/4)^*\ \rho.a^2.g.\lambda$

$=(1/4\pi).\ \rho.a^2.T^2$

Power associated with the wave per unit width, P/unit width

$=(1/8\pi)\ \rho a^2 g^2 T$

Estimation Of Power Associated With Waves-4

- Water waves can be considered to travel along the surface of the sea with an approximate sinusoidal profile.
- They can be characterized in terms of the distance between successive crests (the wavelength, λ) and the time between successive crests (the period, T).
- In deep water these parameters are related as follows

$$\lambda = gT^2 / 2\pi$$

Where g is the acceleration due to gravity.

- The velocity of the waves, C, is given by the following relationship:

$$C = \lambda / T$$

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Estimation Of Power Associated With Waves-4

- Hence, longer waves travel faster than shorter ones.
- This effect is seen in hurricane areas, where long waves generally travel faster than the storm generating them and so the arrival of the hurricane is often preceded by heavy surf on the coast.
- The power (P) in such waves can also be described by use of these parameters and the wave height, H:

$$P = \rho g^2 T H^2 / 32\pi$$

Where ρ is the density of seawater and P is expressed per unit crest length of the wave.

- Most of the energy within a wave is contained near the surface and falls off sharply with depth.