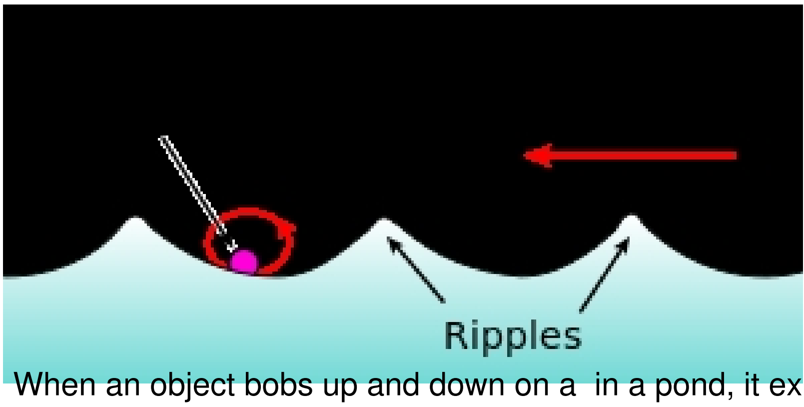
Large storm waves pose a challenge to wave power developers

Wave power is the transport of energi by and the capture of that energy to do useful — for example for , or the of water (into .

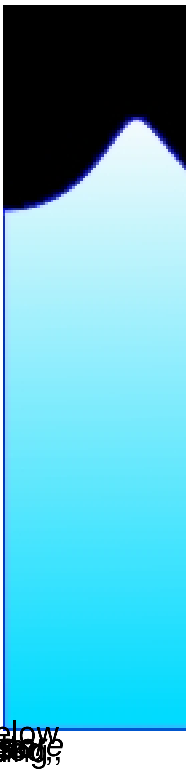
Wave power is distinct from the diurnal flux of and the steady gyre of Wave power generation is not currently a widely employed commercia although there have been attempts at using it since at least 1890. The world's first commercial is based in Portugal, at the whic

consists of three 750 kilowot pelamis devices.

Physical concepts



When an object bobs up and down on a in a pond, it experiences an elliptical trajectory.



[illegible]

[edit] Wave power formula

In deep water where the water depth is larger than half the the wave energy flux is

$$P = \frac{\rho g^2}{64\pi} H_{m0}^2 T_e \approx \left(0.5 \frac{\mathrm{kW}}{\mathrm{m}^3 \cdot \mathrm{s}}\right) H_{m0}^2\ T_e,$$

where

- P the wave energy flux per unit wave crest length (kW/m);
- H_{m0} is the (meter), as measured by wave and predicted by wave forecast models. By definition, H_{m0} is four times the of the water surface
- T_e is the energy (second);
- ρ is the of the water (kg/m^3), and
- g is the (m/s^2).

The above formula states that wave power is proportional to the wave period and to the of the . When the significant wave height is given in meters, and the wave period in seconds, the result is the wave power in kilowatts (kW) per meter of length.

Example: Consider moderate ocean swells, in deep water, a few kilometers off a coastline, with a wave height of 3 meters and a wave period of 8 seconds. Using the formula to solve for power, we get

$$P \approx 0.5 \frac{\mathrm{kW}}{\mathrm{m}^3 \cdot \mathrm{s}} (3 \cdot \mathrm{m})^2 (8 \cdot \mathrm{s}) \approx 36 \frac{\mathrm{kW}}{\mathrm{m}},$$

meaning there are 36 kilowatts of power potential per meter of coastline.

In major storms, the largest waves offshore are about 15 meters high and have a period of about 15 seconds. According to the above formula, such waves carry about 1.7 MW/m of power across each meter of wavefront.

An effective wave power device captures as much as possible of the wave energy flux. As a result the waves will be of lower height in the region behind the wave power device.

Wave energy and wave energy flux

In a the density per unit area of on the water surface is proportional to the wave height squared, according to linear wave theory:

$$E = \frac{1}{16} \rho g H_{m0}^2,$$

where *E* is the mean wave energy density per unit horizontal area (J/m^2), the sum of and

density per unit horizontal area. The potential energy density is equal to the kinetic energy, both contributing half to the wave energy density

E

, as can be expected from the. In ocean waves, surface tension effects are negligible for above a few

As the waves propagate, their energy is transported. The energy transport velocity is the As a result, the wave energy through a vertical plane of unit width perpendicular to the wave propagation direction, is equal to:

$$P = E\, c_g,$$

with c_g the group velocity (m/s). Due to the for water waves under the action of gravity, the group velocity depends on the λ, or equivalently, on the wave T. Further, the dispersion relation is a function of the water depth h. As a result, the group velocity behaves differently in the limits of deep and shallow water, and at intermediate depths:

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