

The Environmental Protection Agency is Queensland's lead agency to promote energy efficiency, renewable power and other initiatives that reduce greenhouse gas emissions throughout the state.



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CLEANER ENERGY

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Wave energy

World-wide, the potential for waves to supply energy is enormous. Dutch researchers have estimated that the world has 20,000km of coastline suitable for harnessing wave power.

There are several ways of harnessing wave power. One approach is to absorb the energy in giant floating devices such as Salter's "nodding duck", developed in the UK, or the Archimedes Wave Swing developed in Holland. These devices use the movement of the wave to pump a working fluid, such as water or hydraulic fluid, through a turbine which is then used to generate electricity.

An important breakthrough came in the 1970s with the development of the Wells turbine, a type of wind turbine designed to turn in the same direction regardless of which direction the air passes through it. The Wells turbine is used in the "oscillating water column" system. Air is forced up through a column as the wave rises, and is

sucked back down as the wave falls, creating an artificial wind in the column.

A tapered channel wave device has been built in Norway. Waves flow along the tapered channel, rising in height until they enter a reservoir above sea level. Power is then generated as the water flows back down to the sea through hydro-electric generators.

Because waves are formed when wind blows across a large body of water, wave energy resources are greatest where the winds are strongest. The energy derived also depends on the height and speed of the waves.

Wave power is still in the development stage with the equipment yet to achieve commercial viability.

Tidal energy

Tidal energy arises from cyclic tidal currents and the tidal rise and fall of the oceans, which are caused by the

Earth's rotation and its interaction with the sun and moon. Tidal and geothermal energy are the only renewable energy sources that do not originate from solar energy.

Of particular significance to harnessing tidal energy is the tidal range, the difference between the water level at high and low tide, which may be affected by the local configuration of land and water. A large daily tidal variation of at least four metres is required to produce useful amounts of energy.

Electricity can be generated from tidal energy by trapping water in an enclosed basin during high tide and

allowing it to pass through turbines while the basin is emptying at low tide.

If a barrier is placed across the entrance to a bay, the open water will rise to a higher level than the water in the bay as the tide comes in. This difference in water level (the head) creates pressure that can drive water into the bay through turbines installed in the barrier to produce electricity.

As the tide recedes, the water level in the bay remains higher than the level in open water, so water is forced outwards through turbines.

Compared with conventional hydro-electric schemes, tidal schemes operate at very low heads, usually less than 10m. This means that very large volumes of water must flow through the turbines to generate significant amounts of power. The greater the tidal range, the more power can be produced from the same amount of water.

The existing tidal power stations have reversible blade turbines, which can generate power when the tide flows in or out of the bays on which they are located. If the power grid has excess electricity available, the turbines can be used to pump extra water into the bay. In this way, the tidal power station can provide some pumped storage capacity similar to that available from some hydro-electric schemes.

Alternatively, if a second, higher level basin is located nearby, some of the tidal power station capacity can be used to pump water into the second basin. This water can supply power when the tide is turning.

The largest tidal power station was constructed in France in 1965. It consists of 10 reversible turbines with a total power of 240MW. The site has a huge tidal range, varying between 8.5m and 13.5m, depending on the time of year.

Ocean thermal energy

Ocean thermal energy technology (OTEC) extracts energy from the temperature difference between the

Renewable energy

Renewable energy comes from sources that are essentially inexhaustible such as the sun, the wind and the heat of the Earth, or from replaceable fuels such as plants. Prior to the industrial revolution, these sources were virtually the only forms of energy used by humans. During the past 150 years, modern civilization has become increasingly dependent on fossil fuels - oil, coal and natural gas. Fossil fuels form so slowly in comparison with the rate of energy use that they are considered finite or limited resources.

Using renewable energy can provide many benefits, including:

- making use of secure, local and replenishable resources;
- reducing dependence on non-renewable energy;
- helping to keep the air clean;
- helping to reduce the production of carbon dioxide and other greenhouse gases; and
- helping to create jobs in renewable energy industries.

Geothermal, solar, wind, hydro, biomass and wave are all examples of renewable energies.

warm surface waters and deep cooler layers of the ocean. A difference of 20°C is needed at a depth of one kilometre or less for this resource to be useable.

In effect, OTEC uses the ocean as an enormous solar collector. A fluid such as ammonia is used to run a turbine similar to the way steam is used in conventional power stations. This technology is less than a tenth as efficient as conventional power stations, so the equipment needs to pump huge volumes of water to extract the energy required.

OTEC is promising as an alternative energy resource for tropical island communities that rely heavily on imported fuel. OTEC plants could provide islanders with much-needed power, as well as desalinated water.

The cooler, deep ocean water is also rich in nutrients and could be used to cultivate a variety of seafood.

The cost of this technology has so far limited its use to a few demonstration plants in the Pacific, and there are currently no plans for OTEC in Australia.

Queensland's ocean-based resources

Queensland has limited potential to derive energy from waves because the Great Barrier Reef prevents a considerable amount of wave energy from reaching the coastline.

The only potential site suitable for a tidal power station in Queensland is between St Lawrence and Sarina in north Queensland.

For more information

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