

# OCEAN

## WHAT IS OCEAN ENERGY?

The oceans of the world contain vast amounts of energy. In particular, two different forms of ocean energy offer possible energy resources: heat energy (or ocean thermal energy) and the energy of waves and ocean currents.

The oceans cover nearly three-quarters of the surface of the world. They absorb a lot of heat energy from the sun's radiation, meaning that the water on the surface becomes warmer than the deep-ocean water. At the equator, the temperature difference can be as much as 25° C.

Harnessing wave energy and the energy associated with ocean tides is quite advanced. Tides are caused by the gravitational attraction of the moon and sun on the ocean water as the earth rotates beneath them. At most locations on the earth, the oceans cycle through two high tides and two low tides every 25 hours. This means that the sea level goes up and down, and also that strong tidal currents flow through harbour entrances and narrow straits (such as Cook Strait).

Waves and currents are also caused by winds, but these are less regular and less predictable.

## TIDAL ENERGY

The simplest way to harness tidal energy is to install turbines in harbour entrances or straits where strong tidal currents flow. These are like underwater wind turbines. They need to be able to turn around as the direction of the tidal currents change. They must also be firmly fixed to the seafloor, and cables must be laid to bring the electricity onshore. Another way of harnessing tidal energy is to trap the sea water at high tide.

This is done by building a dam-like structure or barrage across a tidal basin or river estuary. A barrage has a set of gates that open when the tide is rising. These gates let the water flow in to be collected in the basin behind the barrage. When the tide reaches its highest level, the gates close and hold the water inside. As the ocean tide level drops naturally, the water is allowed to run out through water turbines built into in the barrage, generating electricity in the process.



THE TIDAL BARRAGE AT LA RANCE RIVER IN FRANCE.  
SOURCE: DAVIDDARLING.INFO

## WAVE ENERGY

Organisations and universities around the world are currently researching and developing new technology to harness the energy of waves.

One technology that is being tested currently uses long slender floats, which are attached end-to-end to form a long flexible tube. This tube floats on the surface of the water. When a wave moves along the tube, each individual float rises and falls to follow the wave motion. The kinetic energy of this motion is captured in the links between each float and used to generate electricity.



## WHAT ARE THE ADVANTAGES OF OCEAN ENERGY?

The oceans contain huge amounts of energy, both heat energy and energy associated with tides and waves.

Tides and tidal currents are predictable, renewable sources of energy. Collecting energy from them has a minimal impact on the environment because currents do not emit greenhouse gases during generation.

## WHAT ARE THE DISADVANTAGES OF OCEAN ENERGY?

Converting ocean thermal energy is still in the experimental stage. It is very inefficient and produces electricity in remote ocean areas, rather than areas where it is most needed.

Tidal energy schemes use waterways as well as the open ocean. They can affect the natural ecosystem and aquatic life. Ocean energy technology is currently expensive to install and maintain, but costs are expected to fall in the future.

## HOW IS OCEAN ENERGY USED IN NEW ZEALAND?

There are currently no ocean energy plants operating commercially in New Zealand. There are a few tidal barrages around the world – the best example is found in La Rance River in northern France. This tidal energy plant can produce up to 240 MW of electricity per year using a 13 m barrage device. There are also prototypes being used to collect energy from ocean waves in Spain and Scotland.

New Zealand is surrounded by water. In some places around the country, there are strong tidal currents and waves that might eventually be used to collect energy.

## ACTIVITIES

### ACTIVITY ONE

Individual or group activity. Students research how the moon and the sun affect the earth's ocean tides. Develop a model and present this to the class.

### ACTIVITY TWO

Students find out the difference between renewable and non-renewable sources of energy. Choose a renewable source of energy and a non-renewable source of energy. Compare their impact on the environment, including climate change.

## SUPPORTING RESOURCES

- World Energy Council: [www.worldenergy.org](http://www.worldenergy.org)
- United Nations Atlas of the Oceans: [www.oceansatlas.org/](http://www.oceansatlas.org/)
- Energy Efficiency and Conservation Authority: [www.eeca.govt.nz](http://www.eeca.govt.nz)
- Aotearoa Wave and Tidal Energy Association: [www.aatea.org.nz](http://www.aatea.org.nz)