

Harnessing the Power of Tidal Energy

Tidal energy is still in its infancy, but it holds great potential in the generation of electricity. This article discusses the capture and transport of energy within ocean wave tidal movements.

A major source of tidal energy comes from the natural rise and fall of the Earth's oceans due to the gravitational interaction between the Sun, the Earth, and the Moon. As opposed to solar and wind power, tidal energy is far more predictable. Major disadvantages of tidal energy, though, are a scarcity of available ocean sources that have high flow velocity or high tidal ranges.

The good news is recent technological advances and knowledge in design (e.g., [dynamic tidal power](#) and [tidal lagoons](#)) and turbine technology (e.g., new [axial turbines](#) and [cross flow turbines](#)) show that the total availability of tidal power may be much higher than once thought. As a bonus, environmental and economic costs may now be able to be lowered to more competitive levels.

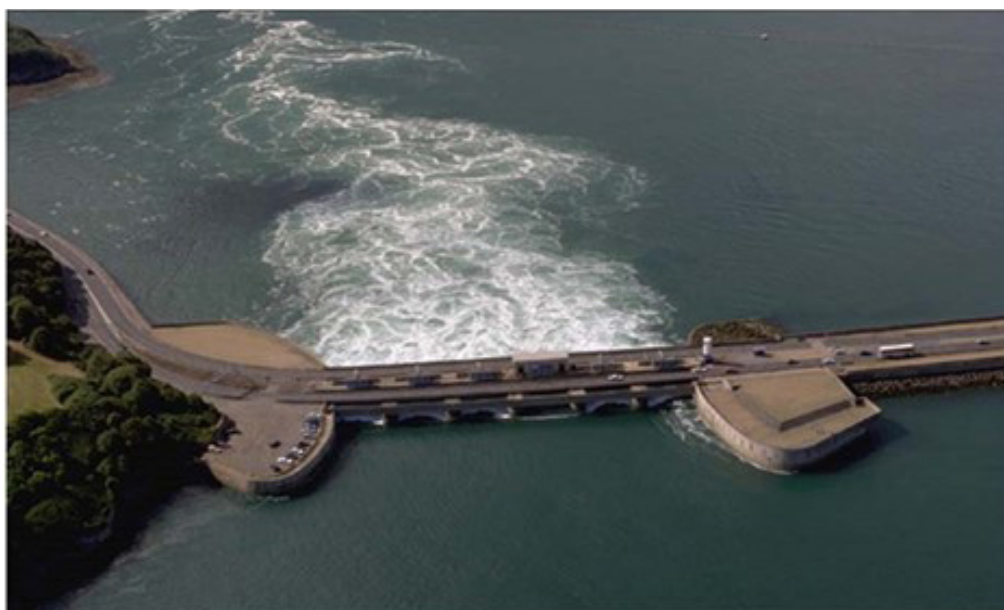
Tidal currents, with sufficient energy, could be used in

harvesting as the water passes through a narrowing region of flow, thus accelerating the water velocity. Exclusive generators, set in strategic locations, would convert tidal energy into electrical power quite easily. Ocean wave motion or currents, along with differences in the temperature or salinity of the sea water, are able to generate energy as well.

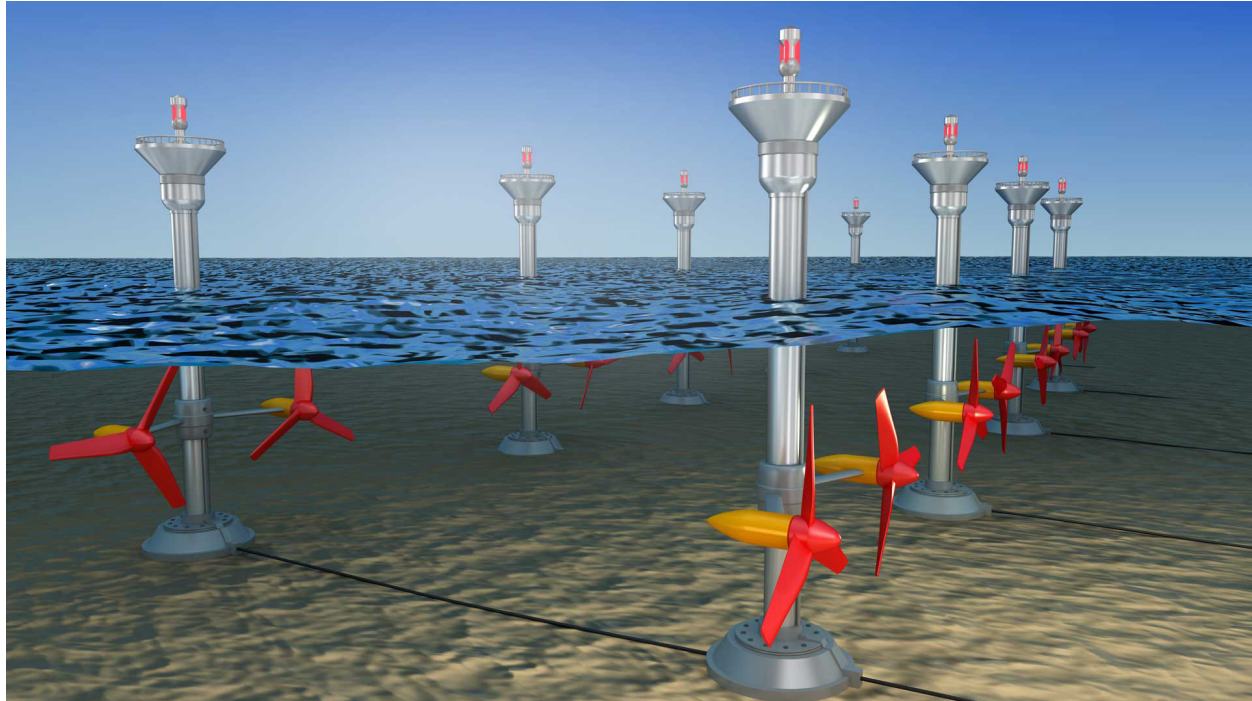
Many of the ideal locations to capture tidal energy experience large differences in tidal range (i.e., the difference between high and low tides). Areas with constricted tidal channels and waterways will generally see more powerful tidal flow.

The U.S. Department of Energy (DoE) claims that tidal, wave, and ocean current energy have a combined potential to generate sufficient electricity to power millions of industries and residential homes.

Because water is denser than the air surrounding us, tidal



1. Shown is the tidal turbine used in France's La Rance Tidal Power Barrage. (Adapted from National Energy Education Development Project [public domain])



2. Tidal energy is a renewable energy powered by the natural rise and fall, as well as the powerful natural flow, of ocean tides and currents.

energy is more powerful than wind energy. Thus, exponentially more power can be produced at the same turbine diameter and rotor speed. Another advantage of tidal power is that it's far more consistent and predictable than either solar or wind energy. This is due to the intermittent nature of both solar and wind.

When tidal energy is made commercially available to capture and convert energy into usable power at scale, as well as finding even more uses of tidal energy, costs will become less sensitive than the National Grid energy.

The Tidal Barrage

To generate reliable energy, tidal power needs a very powerful flow of water. One way to capture this power is when water flows through a narrow channel, like an estuary. An estuary is a partially enclosed coastal body of lightly salted water with one or more rivers or streams flowing into it; a free connection to the open sea helps this effort. Estuaries form a transition zone between river environments and maritime.

Early attempts at tidal power plants employed a dam-like barrage method. This attempt didn't last very long. Some other previous attempts also proved not viable. The good news is that a large [tidal barrage](#) was created in the city of La Rance, France in 1966, and is still in operation today.

La Rance Tidal Power Barrage

The Tidal Power Barrage will generate electricity with traffic traveling along the road on top of it. This was built

on the Rance river in France. The barrage opens sluice gates when the tide is rising to fill the estuary (Fig. 1) that acts as a reservoir. When the tide falls, the sluice gates are closed, and the water is released only through the 24 turbine gen-erators.

This dam is located at a point where the tidal range will reach up to 13.5 meters. It is 750 meters long and creates an artificial lake of 22 square kilometers. The generators can produce a total of 240 million watts of power!

Tidal Power and the U.K. Government

In 2021, the United Kingdom's government initiated the largest investment, in a generation, for tidal power. The goals of this effort are to strengthen energy security and create numerous jobs within the tidal power industry. The U.K. is committed to building a strong, renewable-energy sector to reduce the country's dependence on fossil fuels.

Scottish Secretary Alister Jack commented, "This U.K. Government allocation of funding for the tidal industry in Scotland, and across the U.K., is tremendous news. Harnessing the powers of our seas is a vital step in our transition to the use of greener, cleaner energy and underlines the U.K. Government's commitment to create and protect highly skilled jobs while on our journey to Net Zero by 2050.

"With strong wind and solar power industries in the U.K., it is the natural next step to explore our tidal energy capabilities. It's an exciting development in supporting of our domestically produced renewable-energy sources."





Tidal Stream Generators

The power available for tidal power generation in a given area may be *greater* than a wind turbine due to the higher density of water. A tidal stream generator is shown in *Figure 2*.

Tidal stream generators take advantage of the kinetic energy of the rhythmic flowing water that's able to turn a turbine. These kinds of tidal generators will usually be the least invasive type of tidal power generation.

The Possibilities of Tidal Energy

Tidal power offers quite a unique source of renewable energy. When there's a difference in area between high tide and low tide, it allows for a very positive and powerful generation of electricity. On top of that, there's a machine that can convert one kind of energy to another, such as by changing mechanical energy into electricity, further lending credence to the possibilities of tidal energy.

References

[UK government announces biggest investment into Britain's tidal power](#), November 24, 2021.

[Tidal energy](#), BBC.