Bite-size Climate Science

Tidal Power

A neglected (and under-funded) source of dependable renewable energy

SALISBURY ECO-HUB ALLIANCE

Critics of renewable energy often claim that wind generators and solar panels cannot be relied upon because they depend on the weather. Some days are sunnier or windier than others, so renewable energy is intermittent and unpredictable, they say. The same cannot be said about tidal power, because the tide rises and falls twice a day, whatever the weather, as regularly as clockwork.

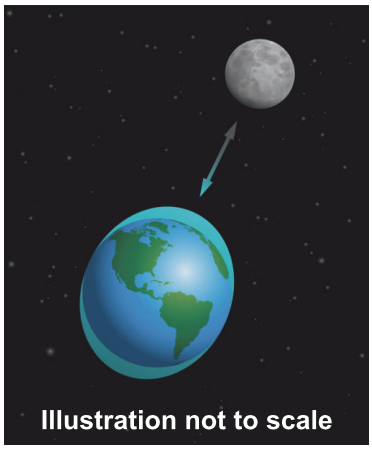


Illustration not to scale

The tides result from the gravitational attraction of the moon acting on the water in the Earth's oceans, together with the rotation of the Earth itself. The sun's gravity also has some effect, but the effect of moon's gravity is greater because the sun is 400 times further away, and the strength of gravity is reduced by the square of the distance.

The highest tides each month occur on new moons and full moons when the sun, Earth and moon are in a straight line, so the forces are all pulling in the same direction. The highest tides each year occur on new or full moons in spring and autumn, when the Earth's orbit is slightly closer to the sun, so the sun's effect is at its greatest.

This constant movement of water is a hugely powerful force of nature, and is completely sustainable, because the daily, monthly and yearly cycle of tides will continue as long as the moon carries on going round the Earth and the Earth continues to rotate on its axis and orbit the sun.

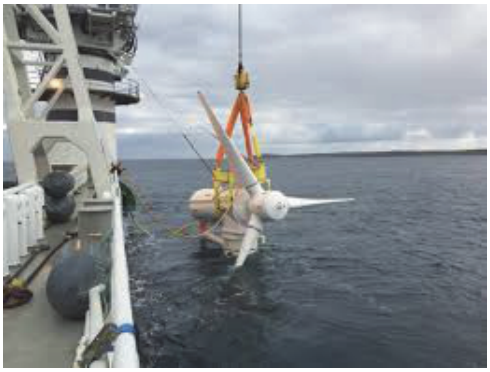
The potential of tidal power has been ignored for too long

Making use of tidal power is not a new idea. The oldest known examples of tidal mills, using the power of the tide to grind grain, date from Roman times. However, in recent decades the potential of tidal power has been sadly neglected in the UK, despite our long coastline and the widest tidal ranges in the world. The UK is ideally placed to lead the world in the development of tidal energy, but successive governments have directed funding towards nuclear power instead.

Harnessing the power of the tides

Tidal power can be harnessed in a variety of ways, and research has therefore gone in a number of different directions. Undersea turbines work like windmills on the seabed, turned by tidal currents instead of wind. Because water is much heavier than air, it carries much greater power and momentum, so underwater turbines can generate more power at slower speeds than wind turbines. Tidal barrages across river estuaries build on the ancient concept of tidal mills in order to generate electricity. Tidal lagoons are a more recent concept, similar to barrages, but using an artificial empoundment or 'lagoon' off-shore.

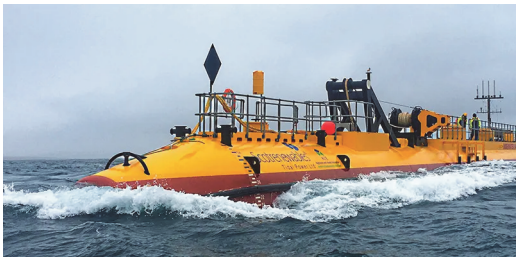
Turbines under the sea



Despite the chronic lack of consistent funding, compared to other renewable energy sources like solar PV and wind (particularly off-shore wind), UK researchers are world leaders in the testing and evaluation of undersea turbines.

The European Marine Energy Centre (EMEC), based in Orkney off the north coast of Scotland, is the world's first marine energy test facility, established in 2003. It has supported the deployment of

more wave and tidal energy devices than at anywhere else in the world, and provides a variety of test sites in real sea conditions. I ts grid connected tidal test site is located off the island of Eday, in a narrow channel which concentrates the tide as it flows between the Atlantic Ocean and North Sea. This area has a very strong tidal current, which can travel up to 4 metres/second (8.9 mph) in spring tides. Tidal energy developers from across the world have tested at the site.



Launched in 2016, in its first year of testing Scotrenewables' prototype floating 2 MW marine turbine (left) produced 3 GWh of power, up to a quarter of Orkney's electricity demand.
In 2019, MeyGEN generated 13.8 GWh from four tidal turbines on the Pentland Firth seabed (like that pictured overleaf). The company now have a contract for 28 MW and the site has consent for another 52 MW, with potential for a further 312 MW to be deployed beyond that.

Tidal Barrages

France led the way in the deployment of tidal barrage technology for electricity generation with the opening of La Rance tidal power station in 1966. It has been successfully generating ever since, and paid back its construction costs within 20 years.

Power is generated from both the incoming and outgoing tides, and costs just €0.12 (about 11p) per kWh. La Rance's peak output of 240 MW was only overtaken by South Korea's Sihwa Lake tidal power station in 2011 with a capacity of 254 MW.

La Rance tidal power station, Brittany

Plans for a similar tidal barrage across the River Severn have long been debated in the UK, but have repeatedly been turned down, due in part to environmental concerns over the mudflats of the Severn Estuary which are a vital habitat for migrating geese and other threatened species.

Tidal Lagoons - and a UK Government u-turn

A new take on the tidal barrage concept is provided by the idea of tidal lagoons. Instead of damming a river estuary (as at La Rance or in the River Severn proposals) a circular artificial lagoon would be built off shore. This would function in a similar way to a barrage, filling up from the incoming tide and emptying at low tide, with power being generated by both the inflow and the outflow. However, unlike a barrage, this would not block off the flow of the river, or cause damage to wetland habitats on the shoreline.

A tidal lagoon in Swansea Bay, which would have been the first in the world, with a generating capacity of 320 MW, got development consent from the UK Government in 2015, and in June 2018 the Welsh Government pledged £200 million towards the construction cost of £1.3 billion. However, the UK Government then withdrew its financial support for the scheme. Evaluations of its financial viability varied, depending on how many years of generation were taken into account. Proposers argued that it would last for at least 100 years, while the UK Government took a 35-year view which made it seem less economic. Neither foresaw the big increase in electricity costs in 2022.

If the Swansea Bay scheme had gone ahead, it could have been followed by similar lagoons off the North Wales coast, in Cardiff Bay and the Bristol Channel, and given the UK a lead in a new technology with worldwide potential. Supporters are still looking to raise new financial backing.

The various forms of tidal power all have enormous potential, but like all new technologies, they need consistent initial development funding, which they have too often been denied so far.

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