Tidal Energy -- All Renewables Are Not Created Equal

Source: forbes.com

Published: July 27, 2017

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Most everyone has heard of hydroelectric energy or hydropower, that uses a dam to store water in a reservoir. Water released from the reservoir flows through turbines, spinning them to generate electricity.

Tidal turbines harness marine currents and tidal energy using tidal stream turbines that work much like submerged windmills, but are driven by flowing water rather than by air. Marine Current Turbines

But there are other types of hydropower that harness marine currents, tidal energy and wave energy, also referred to as marine current energy. Tidal stream turbines work much like submerged windmills, but are driven by flowing water rather than by air (see figure).

According to Professor Jason Donev at the University of Calgary, tidal power is far more reliable than either wind or solar power as the sun doesn't always shine and the wind doesn't always blow. "We know how much electricity we're going to generate at any given time, but tidal is

still intermittent. Although it is very predictable, it's still non-dispatchable – we can't choose to turn it on or off like a dispatchable natural gas power plant," says Donev.

However, the inherent predictability of tidal power is highly attractive for grid management, removing much of the need for back-up plants powered by fossil fuels.

Tidal turbines can be installed in the ocean at places with high tidal current velocities, or in places with strong and continuous ocean currents. These flows are basically as predictable as the tides. The technology shown above consists of twin axial flow rotors of 15 to 20 meters in diameter, each driving a generator via a gearbox much like hydroelectric and wind turbines. The twin power units of each system are mounted on wing-like extensions on either side of a tubular steel central pillar some ten feet in diameter, set into a hole drilled into the ocean floor.

Marine currents, unlike many other forms of renewable energy, are a consistent source of kinetic energy caused by regular tidal cycles driven by the phases of the moon. Water is over 800 times denser than air so the force of the tidal flow, of only several miles per hour in places like Strangford Lough in Ireland, is similar to that produced from a 300 mph wind on a wind turbine.

This difference in density and power also means that tidal turbines can be significantly smaller than wind turbines. Tidal turbines can be placed much closer together and still generate the same amount of electricity.

The United Kingdom leads the world in marine current energy and has more companies involved in this area than any other. The ocean surrounding the U.K. has vast quantities of predictable, reliable and consistent marine current energy.

A study by the U.S. Department of Energy identified almost 50 GW of marine current power in the Alaskan coastal waters alone. The World Energy Council estimates that up to 1,000 GW of marine energy could be installed by mid-century. This is pretty significant, equivalent to half of the world's present coal capacity.

Costs for marine current energy are still being developed and are coming down, but estimates by the International Renewable Energy Agency range from 20¢ to 27¢/kWh.

Environmental impact studies of marine energy have shown relatively little impact to marine ecosystems. These studies focused on the effects of the turbines on the integrity of the breeding harbor seal population, the abundance, diversity, integrity and extent of the benthic biological communities associated with the submerged rocky reefs, and the population of breeding seabirds.

But researchers at Cardiff University and Liverpool aren't so sure. There are concerns that tidal power could have negative impacts on marine life by changing how sedimentation, dissolved oxygen and nutrients work in the area. Extensive modelling is required to look at how these will be affected.

Barring any strange unlooked-for negative effects, marine current technologies should grow quickly in this century and become a solid part of our future low-carbon energy mix.