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The emergence of a new contender

By Ed Feo & Marco McClees

Ed Feo is a partner in the international law firm of Milbank, Tweed, Hadley & McCloy LLP. He co-chairs the Firm's project finance and energy practice and is a member of the Firm's Global Executive Committee.

As interest in renewable energy sources and technologies continues to grow, hydrokinetic energy projects (commonly referred to as tidal or wave energy) hold the potential for a significant addition to the world's energy supply. It has been estimated that the ocean could provide 2-TW of energy. Though tapping into the ocean to generate energy has a history dating back to at least the Middle Ages, there has been a recent renewal in efforts that promise to make hydrokinetic energy projects a significant, viable alternative in the renewable energies market. However, these projects face significant hurdles before they can become commercial contenders.

Currently, ocean hydrokinetic energy projects can be divided into two basic categories: wave energy (projects converting energy from the motion of ocean waves), and tidal or current energy (projects converting energy from the motion of ocean currents or tides). These can further be divided into those that transmit to existing electrical grids and those that serve as local sources of power. There are various technologies in the marine renewables market, with at least 80 different devices being tested and deployed globally as of 2007. In the wave field, the four best known devices are: point absorbers, oscillating water columns, overtopping terminators, and attenuators. In the tidal field, the four best known categories of devices are: vertical-axis turbines, horizontal-axis turbines, Venturi systems, and oscillatory systems.

By May 2008, in the US alone, the Federal Energy Regulatory Commission (FERC) has issued 40 permits to ocean hydrokinetic energy project developers (mainly for testing), 32 for tidal/current projects, and 8 for wave projects. Of the 21 ocean projects still awaiting permits, 21 are for tidal/current projects, and 7 are for wave projects. These permits and testing processes are crucial if hydrokinetic energy is ever going to reach its estimated potential of providing 10% of US energy.

However, FERC is not the only governmental agency with jurisdiction over marine projects. At the federal level, the Army Corps of Engineers (Dept. of Defense), the National Oceanic and Atmospheric Administration (Dept. of Commerce), the Marine Management Service, the Coast Guard, the National Marine Fisheries Service, the Environmental Protection Agency, the Minerals Management Service (Dept. of Interior), and the Fish and Wildlife Service are just some of the departments or agencies that may be involved in the regulation of hydrokinetic projects.

In addition to the need for an efficient regulatory framework, government support for the advancement and increased use of these technologies will be critical to the industry becoming competitive early on. At present, governmental support appears to be strongest in the UK and Western European countries with rich marine resources. For example, in the UK, there are at least two forms of governmental support for hydrokinetic energy projects providing grant support for capital costs

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and revenue subsidies: one by the Scottish Executive and another by the Marine Renewable Deployment Fund (through the Dept. of Trade and Industry). Last year alone, the Scottish Executive announced roughly $26 million in grants for these projects. The US has also begun to show support through bills introduced in Congress (such as The Marine and Hydrokinetic Renewable Energy Promotion Act of 2007), which could provide funding for research as well as tax credits.

Compared to other renewable energy projects, like solar or wind, hydrokinetic energy projects benefit from well-documented collections of global tide, current, and wave data that provide would-be developers with significant advantages in the planning phases. Moreover, these data collections provide operators with advanced notice of fluctuations in the power levels so that preparations can be made to provide consistent power levels to users. Load factors for wave energy projects are also higher than wind and solar, ranging between 30-40%, whereas wind is between 25-35%, and solar is between 10-20%. These higher load factors translate to more efficient and higher output projects. Another benefit to hydrokinetic projects is the minimal visual impact created by the various technologies used. It is further presumed that the environmental impact of these projects will be very small to none at all (though significant studies have yet to be completed).

Unfortunately, there are uncertainties surrounding this nascent market that may prevent its ability to move past the R&D phase and into the commercial market. A major one is determining which technologies will become market leaders. This is due, in part, to the uncertainty of the industry, as well as to the sheer number of technologies. The manufacturers also tend to be small companies that have not achieved economies of scale in production. Yet another concern is the level of collective experience in the industry. By 2007, only 15 companies globally had "in-water" experience (mostly small testing). Due to the lack of significant experience "in-water," other concerns arise over access to the devices for maintenance, longevity of the devices under the conditions produced by the marine environment, and the potential impact on the environment. Finally, the industry doesn't currently have manufacturers with the financial standing necessary to provide the kind of warranties of performance to support long-term project financing.

An additional hurdle to commercial viability is the estimated cost per kWh. Notably, some estimates suggest that costs would be lower than those faced by the wind energy field during its early commercial development. Current estimates for wave energy projects are in excess of 25¢ per kWh (varying depending on whether the sources supply local power or plug into a grid). With much higher volumes the estimates fall to a range of 3-4¢ per kWh (for those integrating into a grid system) and 7-10¢ per kWh (for those local sources). These latter rates would compare favorably with wind and solar based on expected cost curves.

There are a handful of pilot projects deployed globally. Verdant Power has one pilot tidal energy project installed in New York City's East River generating 210-kW. To provide a sense of scale, in 2003, the International Energy Agency determined that the average US residence used 1.3-kW of energy, therefore, Verdant's project could power roughly 161 homes. Another developer, Ocean Power Technologies, has deployed three 40-kW buoys for the US Navy's Hawaii base. In December 2007, Finavera Renewables Ocean Energy's 1-MW wave buoy project, located two nautical miles off of Washington's coast, became the first hydrokinetic project to obtain a FERC license (as opposed to a permit) and the first wave project with a power purchase agreement from a public utility. Other test projects are being installed off the coasts of Spain, Scotland, France, Australia, Portugal, and Canada, among others.

The marine environment clearly holds an enormous untapped potential for the energy markets; however, unless the hurdles of technology, permitting and financing can be overcome, hydrokinetic energy developers may never cross the R&D horizon or successfully enter the commercial market. It will be crucial for developers to prove successful technologies to lead the market, for governments to streamline the permitting process (at least in the early days of this market), for governments to provide incentives (whether it be tax credits or grants for R&D) and, ultimately, for cost per kWh to decrease for these projects to realize their potential in the renewables energy market.

Milbank, Tweed, Hadley & McCloy LLP
www.milbank.com

Edwin F. Feo, Partner
Milbank
601 South Figueroa Street, 30th Floor
Los Angeles, CA 90017-5735
Tel: +1 213 892 4417
Email: efeo@milbank.com