Our Ocean Backyard — *Santa Cruz Sentinel* columns by Gary Griggs, Director, Institute of Marine Sciences, UC Santa Cruz.

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Wave power–part 2

The Pelamis is the first commercial system using wave power and was installed off the coast of Portugal.

The waves, tides and currents just offshore contain huge amounts of energy, and this is all renewable. Technologies for converting wave energy into electrical

power are evolving, and renewable energy companies are increasingly interested in converting the energy of California's ocean waters into electricity.

In 2006, the state legislature passed the California Global Warming Solutions Act, which mandates a timetable for significant reductions in greenhouse gas emissions. Wave energy might help reduce these emissions by providing a renewable and reliable source of energy and could also provide a significant number of new jobs. So what's the hold up?

There are reasons why we aren't all hooked up to an offshore grid quite yet. The principal reason is that the technology is still being developed, but economics, permitting and environmental issues are also standing in the way.

A 183-page report was just completed for the California Ocean Protection Council entitled "Developing Wave Energy in Coastal California: Potential Socio-Economic and Environmental Effects." While it's dangerous to summarize an exhaustive report in a few sentences, the study concludes that dramatic ecological, social or economic effects are not clearly indicated. Nevertheless, it makes a strong case for caution when developing wave energy conversion technology along our coast. At this stage, however, the environmental issues appear manageable. So far, so good.

The development of a renewable ocean energy industry in the U.S. has been hampered to date by a number of regulatory challenges. For example, the regulatory system is not designed to encourage pilot and demonstration projects. State and federal governments need to develop a permitting process that encourages development of demonstration projects while being sensitive to protection of the marine environment. Regulation of ocean power development needs to be clear, efficient and organized with a single lead agency.

A second challenge has been a lack of investment in basic research and development of new technologies. The U.S. Department of the Interior has not funded ocean energy research and development in over 15 years, and it shows. The U.S. doesn't yet generate any energy from the ocean--none. But with appropriations from Congress this year, the Department of Energy announced $7.3 million in funding for 14 projects that will employ the power of the ocean's tides, waves, currents and heat. The funding will also finance new National Renewable Energy Centers in Washington, Oregon and Hawaii.

In a report just released in October on the Future of Ocean Power, Greentech Media addresses the underlying fundamentals that will determine when ocean power technologies will become competitive with other renewable and traditional energy sources, what technologies will bring the industry to that point, and how investment, government policies and power industry buy-in will drive the growth of this industry. While fewer than 10 megawatts of ocean power capacity have been installed globally to date (enough to power about 6500 homes), they believe that in 6 years the industry has the potential to have 1 gigawatt of installed capacity, a 100-fold increase. The study analyzed 23 companies that are developing wave energy technologies, of which six have now gone commercial and 4 are listed as pre-commercial.

The technologies that are the most advanced for conversion of wave energy into electrical power fall into four general types:

- An oscillating water column, where the rise and fall of the water in a tube as a wave passes forces air through a turbine that generates electricity.
- Attenuators, such as the snake-like Pelamis, where an elongate and segmented floating tube, about the length of a submarine, flexes as waves pass by, with the up and down motion driving a generator.
- Overtopping, where waves spill over into a floating reservoir with the return flow of water into the ocean driving a turbine.
- Wave buoys or point absorbers, where passing waves cause the structure to rise and fall and uses this motion to turn a turbine.

In September, Portugal completed the installation of the world's first commercial power plant that harnesses wave energy. It uses three articulated steel "sea-snakes" (the Pelamis system) three miles off the country's northern coast. They produce a combined 2.25 megawatts, enough to power 1,500 homes with electricity, but there is optimism for a 10-fold expansion over the next few years.

A year ago--on December 18, 2007--PG&E signed the nation's first commercial power purchase agreement for wave energy, a modest 2 megawatt AquaBuOY project that would capture wave energy off the Humboldt County coast and that expects to begin producing power in 2012. The company that is building the buoy, Finerva Renewables, had just received the first license issued for a wave power project in U.S. waters, which would be in Washington State.

The potential amount of energy is high and the technology is developing quickly. But these efforts need to be encouraged, and we need to streamline the permitting and regulatory process and get some projects in the water. The Electrical Power

Research Institute believes that ocean renewable energy in U.S. waters has the potential to provide 10% of today's electrical demand. It is still too early to predict with any certainty how important wave energy will be in our future, but we need to give it a chance.