TOWER OF POWER: A system in Hawaii generates electricity by exploiting the temperature difference between the ocean's cold depths and warm surface.

OCEAN THERMAL ENERGY: BACK FROM THE DEEP

Makai Ocean Engineering preps a 100-kilowatt test facility on the Hawaiian coast, while others look offshore

This month, the Hawaii-based firm Makai Ocean Engineering will prepare to hoist a small turbine up a spare steel structure with a commanding view of the Pacific Ocean. There, with a flood of near-freezing water piped up from 1,000 meters below the surface, the company will put what will be the largest experimental ocean thermal energy plant through its paces.

Ocean thermal energy conversion, or OTEC, is an approach to energy generation that harnesses the temperature difference between surface and deep-sea waters. It's an energy dream that made inroads in the late 1970s and early 1980s, only to fizzle once oil prices fell. But there are some suggestions that it is again gaining momentum.

Among OTEC's attractions is that unlike other renewable energy sources, it should be capable of generating a steady stream of energy 24-7. "The utilities are excited about it because they don't have to worry about variability," says mechanical engineer Michael Eldred, who manages Makai's test facility. "But the reality is that it is quite expensive, and it is a technical challenge."

Makai's plant uses an approach common in OTEC research today. Warm ocean water is pulled from the surface and fed into a heat exchanger, where it vaporizes a low-boiling-point liquid such as ammonia. This vapor drives a turbine to create electricity. Cold ocean water, drawn from the deep, is then used to condense the ammonia back into liquid to complete the loop.

The finished facility, which will be only a bit higher in capacity than existing test plants in Japan and South Korea, is quite modest by energy production standards. The plant will be able to produce at most 100 kilowatts of power—enough, when operating continuously, to supply electricity to about 80 average American homes.

The plant and its pumps will consume most of the energy produced. But Makai's plant is geared toward research, Eldred notes, not energy generation. The facility was built primarily to design and test heat exchangers, which are among the most expensive components of an OTEC plant. With the addition of a turbine, Eldred says, Makai will be able to design an automatic control system and improve both performance and cost predictions for its commercial plant designs. The company also hopes to get a sense of how fluctuations in the temperature and pressure of ocean water will alter power output, a factor that might prove significant for wave-tossed offshore plants.

That's likely to be where OTEC energy production winds up. A 10-megawatt plant, such as one that Lockheed Martin aims to build for China's Reignwood Group, will require a cold-water pipe that is several meters wide. A plant floating in open water could send a pipe straight to the depth required instead of diagonally, down a long slope extending out from shore. That would make for a shorter and less expensive pipe, reduce the impact on the landscape, and cut down on the energy required to pump the cold water.

The first large-scale plant to make the leap could be New Energy for Martinique and Overseas (NEMO), says Luis Vega of the University of Hawaii's National Marine Renewable Energy Center. The project, which is a collaboration between renewable energy firm Akuo Energy and naval defense company DCNS, both based in Paris, plans to construct a 16-MW plant about 5 kilometers off the shore of the island of Martinique.

Construction is set to start next year, and the team aims to have the plant operational in four years. When complete, NEMO should be able to supply some 11 MW of energy to the Caribbean island.

NEMO will be the "first industrial-scale, turnkey" OTEC plant to go into operation, says Emmanuel Brochard, who leads the OTEC effort at DCNS. And it will get some help. In July, the European Commission awarded up to €72.1 million to help subsidize the first five years of the plant's operation. This is a vote of confidence in the technology, Brochard says. "OTEC is no longer R&D," he says. "It is a real, new source of renewable energy." —RACHEL COURTLAND

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