THE BLUE-GREEN REVOLUTION

Unlocking the eco-potential of deep ocean water

BY AMY WESTERVELT

IN A LAB built over craggy black lava fields, on a typical 90-degree day, researchers at the Common Heritage Corporation in Hawaii take a break from their work to enjoy the fruits of their labor—literally. They snack on grapes and pineapples grown in their test garden with their ColdAg method, a process that uses pipes filled with deep ocean water to cool hot soils and create condensation to irrigate crops. And when the researchers return to work, they, like the soil outside, are kept cool by seawater: Their building (which is on the grounds of the National Energy Laboratory of Hawaii Authority, or NELHA, an alternative-energy research facility) has cold ocean water running through its air conditioning system.

In the last 15 years the Common Heritage Corporation (CHC), a privately held, for-profit company, has pioneered several innovative uses for deep ocean water. Led by ocean engineer John Craven, who also cofounded NELHA, CHC researchers have developed deep-ocean technologies like air conditioning, irrigation, freshwater production, and even electricity generation. Craven's ideas have not taken over the world yet, but they are being embraced in many countries, including developing ones. The technologies are particularly attractive to island nations, which often have scarce natural resources, high living costs (because most goods need to be imported), and little industry except tourism. Unlike many eco-friendly technologies, cold-water air-conditioning pipelines are relatively affordable, generally paying for themselves within two to three years; these pipelines can also help significantly reduce the cost of running hotels and other tourist destinations that use huge amounts of fresh water, electricity, and energy.

How does ocean water work its magic? First, the air conditioning: water is siphoned from thousands of feet below the surface of the sea and pumped into traditional chilled-water air conditioning systems, which typically work by using a coolant to chill the water that is piped throughout the building. With CHC's system, the electricity-guzzling chillers are unnecessary: Deep-ocean water is already a bracing 39 degrees. Seawater cooling systems save tenants more than 80 percent on their electricity bills, requiring very little energy to keep cold water flowing. Their by-product, room temperature water (which is clean and poses no threat to the ecosystem), is returned to the ocean several hundred feet higher, so that the sea's natural temperature variations are not disrupted. The pipelines are made of corrosion-proof plastic.

Pipes carrying deep water can also run beneath gardens or fields; placed half a foot below the surface, the pipes chill the roots of plants, and the temperature difference between the water and the soil causes enough freshwater condensation on the pipes to irrigate the plants as well. By turning the flow of cold water on and off, researchers at CHC have found that they can effectively force plants into and out of dormancy to increase production. In their tests, researchers at CHC have harvested three crops a year from their vineyard and can produce a crop of pineapples in 8 months instead of 18.

Plans for such technologies are already well under way in several island nations. This year the Tahitian island of Bora Bora will become home to the world's deepest ocean pipeline to date, more than 3,000 feet below the water's surface. The pipeline, constructed by Makai Ocean Engineering (the same company that designed and installed pipelines for NELHA), will provide air conditioning to several beachfront hotels. Meanwhile, energy officials on the Caribbean island of Curaçao and the U.S. territory of Guam have been meeting with engineers to discuss the possibility of replacing conventional air conditioning systems with seawater systems for groups of hotels on their shores, and officials from the African island of Mauritius are looking to make the switch in the next few years.

Dr. Craven and his CHC colleagues are planning a complex, much larger version of their NELHA project on Saipan, a U.S. territory in the Marianas and a popular island destination for tourists from nearby Japan (Tokyo is a two-and-a-half-hour flight away). Saipan has a limited supply of fresh water, so it must use an expensive desalination process to "create" more; the island also imports all of its oil and more than 90 percent of its food, which is extremely costly. CHC plans to install a two-foot-diameter pipe on the northern tip of the island, which would supply fresh water, air conditioning, cold-water irrigation, and partial electrical power to a 100-acre development that it plans to build with the help of the local government and an as-yet-unnamed business partner. The development would include town houses, a golf

PHOTOGRAPH BY PAUL BRUNETTI

course, soccer fields, and an athletic complex. CHC will also sell fresh water to hotels and businesses on the island.

Cold-water technology has gained traction elsewhere in the world. By 2007 many of the resorts, office buildings, and retail businesses in downtown Honolulu will get their air-conditioning from a pipeline that is 5.25 feet in diameter and 1,600 feet below the surface of the ocean. In addition to projected electricity savings of 80 percent (which means a lot in Hawaii, where air conditioning accounts for roughly 40 percent of annual electricity costs), Honolulu Seawater Air-Conditioning, the company that's overseeing the project, estimates that the system will conserve 400 million gallons of potable water a year and eradicate the 126 million gallons of wastewater created annually by the coolants used in existing air conditioning networks.

The technology's usefulness is not limited to tropical zones; after all, deep ocean water in cooler climates is even colder. In Halifax, Nova Scotia, a joint project between the Canadian government and a private company tapped into deep ocean water in the late 1980s to cool a 350,000-square-foot office complex along the waterfront. Because of the area's low water temperatures, the project required only a small pipeline at a depth of less than 100 feet, which cost only $200,000. Savings on electrical costs, maintenance staff, freshwater usage, water treatment, and cooling-tower maintenance totaled between $50,000 and $60,000 per year. Today the system has been expanded to serve the entire waterfront. And one of the most successful deep-water projects on record uses cold water not from the ocean but from a freshwater lake. A pipeline in New York's Lake Cayuga provides air-conditioning for the entire Cornell University campus, with an energy savings of 86 percent. By 2004 the Cornell project had convinced the City of Toronto to jump on the deep-water bandwagon, and now the Canadian metropolis boasts three 5.25-foot pipelines reaching 4.5 miles into Lake Ontario. The system air-conditions nearly 30 million square feet of office space in downtown Toronto; water used in the cooling system is recaptured and purified for drinking.

> THE SYSTEM WILL CONSERVE 400 MILLION GALLONS OF POTABLE WATER A YEAR AND ERADICATE THE 126 MILLION GALLONS OF WASTEWATER CREATED ANNUALLY.

Deep-water technologies are not for everyone, of course. The capital cost of a pipeline and distribution system is high, ranging from $2 million to $5 million. What's more, there is an economy of scale associated with deep-ocean technologies: Air conditioning systems that hold less than 1,000 tons of water (enough cooling for a 500,000-square-foot building or group of buildings) are more difficult to justify. Deep-ocean air conditioning works best with what is known as a district cooling arrangement, where many buildings are cooled by the same system.

On the bright side, Craven argues, the latest advancements in deep-ocean technology could have benefits for all of us, no matter where we live. Deep ocean water contains trace minerals that are believed to benefit human health. There are currently three companies at NELHA bottling and selling desalinated deep ocean water, a drink that has become popular in Japan. Meanwhile, Craven has been experimenting on himself, applying the water to various parts of his body, and has concluded that deep ocean water helps the body heal itself. Not one to sit around and dream, Craven has already patented his cold-water therapy and is talking about opening up a cold-water spa in Kona. If it's anywhere near as successful as his other ventures, we could discover that we've been surrounded by the fountain of youth for centuries. ■