

Hawaii has become an incubator for all sorts of renewable-energy projects

By JIM CARLTON

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HONOLULU -- A state better known for sun and fun is quietly morphing into one of the world's leading incubators of alternative energy.

Royal Dutch Shell PLC is heading up a test venture in Hawaii to turn oil-rich algae into fuel. If the process is found commercially viable, the Anglo-Dutch conglomerate could build algae-processing plants elsewhere.

Ever-Green Energy LLC of St. Paul, Minn., plans to build a plant in Honolulu that uses seawater to cool office buildings; if successful, the project will be expanded to other states. A start-up company, meanwhile, is deploying miniature solar-thermal collectors on Oahu to help generate more power for the local electricity grid. This set-up, too, if successful, will be reproduced elsewhere.

The reason for all the interest: location, location, location.

"Hawaii is the only place in the world where you have access to every form of renewable energy, and you are on the dollar and the U.S. legal system," says Joelle Simonpietri, a former venture capitalist who now heads an algae-to-fuel firm called Kuehnle AgroSystems Inc.

Hawaii is trying to convert to clean energy as fast as it can. Petroleum imports make up about 80% of the energy supply for Hawaii's main utility, leaving the state among those hardest hit by the run-up in oil prices. Electricity rates have gone through the roof. The average residential rate on Oahu, where most of Hawaii's 1.2 million residents live, had doubled to 25.50 cents a kilowatt hour -- the highest in the U.S. -- from 12.74 cents in 1999, according to [Hawaiian Electric](#) Co., the state's major utility.

So, in January, Gov. Linda Lingle announced plans under a state-federal partnership for Hawaii to derive 70% of its energy from renewable sources by 2030 -- one of the most ambitious targets in the world.

The state has gotten a head start toward this goal in some places. On Maui, for example, wind farms power 11,000 homes, or about 10% of that island's energy, while on the Big Island, which is Hawaii itself, geothermal power from volcanic vents accounts for about a fifth of the energy there.

And on Oahu, Hawaiian Electric is building a new power plant that will generate 110 megawatts -- enough power for about 30,000 homes -- and will run completely on biodiesel fuel. The \$160 million plant, expected to open next year, will initially get its fuel from imported palm oil.

"Everything is possible as oil prices rise," says Henry Montgomery, chief executive of MontPac Outsourcing, a finance and accounting consultancy in Honolulu.

Not all the technologies are problem free. Environmentalists want to make sure, for example, that Hawaiian Electric doesn't import any of its palm oil from endangered rainforests in Asia. Utility officials say that their palm oil will come from sustainable sources, and that over time the plant will rely more on crops grown in Hawaii.

There's also a question of whether the sources of energy can overcome technical hurdles, among other challenges.

Gov. Lingle, for her part, says Hawaii is counting on a multitude of the clean-energy technologies to succeed -- not any particular one. "If our experience with petroleum has taught us anything, it is not to get reliant on any one source of energy," the governor said in a recent interview at her state capital office, where, moments earlier, the power went down due to a temporary malfunction.

Here is a sampling of what's going on in Hawaii:

SOLAR

One of Hawaii's most abundant resources is its sunshine. But like many places, solar power used to cost so much more than conventional power it largely wasn't economical -- until oil prices got so high.

Now, several solar companies in Hawaii are trying to cash in on the boom in clean-energy demand. [Hoku Scientific](#) Inc. until last year specialized in making fuel cells. Now the Honolulu company makes silicon for photovoltaic solar cells at a factory in Idaho, while in Hawaii it installs solar panels for mostly corporate customers including the Bank of Hawaii and Hawaiian Electric. "Obviously, with the high electric rates, Hawaii is a great place to sell alternative energy," says Darryl Nakamoto, Hoku's chief financial officer.

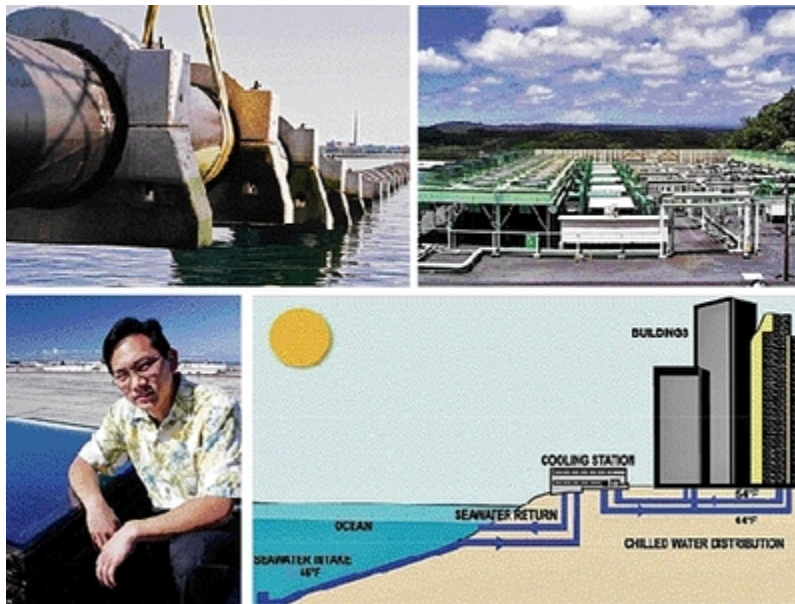
Another company, Sopogy Inc., is augmenting local power with solar-thermal energy, a technology that uses mirrors and lenses to concentrate the sun's rays on fluids, creating steam that turns turbines to generate electricity. Spun off last year from a technology company called Energy Industries, Sopogy has created a miniature version of the giant solar collectors found in places like the California desert. "Micro" collectors weigh about 100 pounds, measure 12 feet by five feet, and can be deployed on building rooftops, Sopogy officials say. Also, unlike many technologies that tap the sun, Sopogy has designed its system so it can store solar energy, the company says.

Last year, Sopogy got \$10 million in state revenue bonds to set up a one-megawatt demonstration farm on Hawaii. In May, the state Legislature approved \$35 million in bonds to help Sopogy build a solar plant on Oahu that will generate 10 megawatts, or enough power for about 3,000 homes, for Hawaiian Electric. Privately held Sopogy has raised more than \$10 million in other money as well, including from Kolohala Ventures, a Honolulu venture-capital firm.

If successful, Sopogy hopes to expand its micro solar plants around the world. "We want to see our revenues at \$1 billion in five years," says Darren Kimura, president and chief executive of Sopogy, and founder of Energy Industries.

ALGAE

One of the holy grails in alternative energy is a system that can extrude oil from algae on a grand, and economical, scale. Scientists say oil represents as much as half the body weight of algae, compared with about 20% for corn, one of the most widely used biofuel crops. Algae also grows as much as 10 times faster than corn, and can be processed for oil without disrupting food supplies.



RENEWABLE SOURCES A seawater cooling project for downtown Honolulu would be similar to an Enwave Energy project in Toronto (top left); Ormat Technologies' geothermal plant in Puna (top right); Darren Kimura, president and CEO of Sopogy, a solar-thermal energy firm; and a diagram of a deep-water cooling system.

However, the technical challenges have proven large in the past. For example, studies have shown algae strains that can produce the most energy often need to be starved of nutrients, which stunts their growth. Indeed, some previous efforts in the U.S. and Japan over the past 30 years have been dropped, in part, because costs were exorbitant.

But now that oil is so high, several companies are turning to algae again. One of the more closely watched is Cellana, a Shell-led venture with a University of Hawaii spin-off, HR Biopetroleum. The companies announced in

November 2007 that the venture would build a pilot facility on the Big Island's Kona coast. Since then, researchers have been busy planting various strains of algae in test tubes that sit in the warm sea water on the Kona coast. One of the tasks facing them is to find algae that both contains the highest amounts of oil and can grow in warm water. "We're in the process of whittling down the top super bugs from hundreds to 10," says Susan Brown, a University of Hawaii researcher who collects specimens for the project on scuba dives around local waters.

SEAWATER

One of the simplest clean-energy concepts is to take cool water from the ocean or a lake and use it to help air-condition buildings in nearby cities. The technique has been used in places like Amsterdam and Toronto, with significant power savings.

But piping water to where it needs to go requires more capital investment than many places were willing to make when oil was cheaper. Until recent years, there were also limitations on how deep pipes could be put to suck up the colder water.

In 2003, David Rezachek -- a former manager of Hawaii's alternative energy program -- held a workshop in Honolulu to revive local interest in seawater air-conditioning. Even then, Hawaii's electric rates were the highest in the country. "I said, 'It's time to quit talking about it, let's do this thing,'" Mr. Rezachek recalls.

He helped get Ever-Green Energy -- then called Market Street Energy -- to set up a subsidiary called Honolulu Seawater Air Conditioning. The company invested about \$3.5 million in the venture, while \$10.8 million has been raised from mainland and Hawaiian investors, including Kolohala Ventures, says Mr. Rezachek, associate development director for Honolulu Seawater. The state Legislature has also authorized \$100 million in tax-exempt revenue bonds for a seawater cooling project.

The venture proposed in late 2003 a seawater cooling project be built for downtown Honolulu. Although ocean temperatures on the beaches around Oahu hover in the mid 70s, they drop to 45 degrees at 1,600 feet deep a few miles offshore. So Honolulu Seawater proposed to run a pipe from 1,600 feet deep to a cooling plant onshore, four miles away. The cold seawater would pass through a heat exchanger where it would cool fresh water from separate pipes used to chill nearby office towers downtown.

Designed to cool 12.5 million square feet of office space -- or the equivalent of almost five Empire State Buildings -- the Honolulu system is projected to save as much as 15 megawatts of conventional power, while at the same time cutting greenhouse gas emissions by 84,000 tons a year. The venture expects to secure permitting by early next year, and be in operation in 2010 at a cost of about \$165 million.

GEOHERMAL

Few places in the world have as much geothermal energy potential as Hawaii's Big Island, where the Kilauea volcano has been erupting since 1983. As long ago as 1881, Hawaiian King David Kalakaua met with inventor Thomas Edison to discuss harnessing the power of Hawaii's volcanoes.

In the 1970s, a public-private partnership dug the first geothermal well in Puna on the windy east side of the island. Over time, enough hot water and steam was taken out of the ground to fuel a 30-megawatt power plant. The plant, owned by Reno, Nev.-based Ormat Technologies Inc., provides power to about 10,000 homes, or 18% of the Big Island's total supply, according to Hawaiian Electric.

Conceivably, the Kilauea volcano could provide enough power to meet all of Hawaii's needs, state utility officials say. But there are several limitations. One is the Big Island's isolation from the other Hawaiian islands. For example, the ocean is so deep between it and the next closest

island, Maui, that officials in the state abandoned a past plan to try and lay an underwater cable between the islands to transfer the geothermal energy.

Another issue: opposition to significant expansion of geothermal by some native Hawaiians, on grounds the volcano is sacred, says Robert Alm, a spokesman for Hawaiian Electric.

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