



COURTESY HR BIOPETROLEUM

Phycal is one of several companies exploring algae as a commercial source for biofuel in Hawaii. Others include HR BioPetroleum Inc., which partners with Royal Dutch Shell Plc to run a marine algae venture, above, on a 5-acre test project on the Big Island.

Microalgae, massive project

An energy firm is using 40 acres in Wahiawa to test plants for use as a renewable biofuel

Star Advertiser 6/12/10
By Andrew Gomes

Many plants have good potential to become renewable sources of biofuel in Hawaii—palm, jatropha, soybean, sunflower—but one group, microalgae, is on track to soon undergo a pivotal test locally.

The test is a \$65 million pilot project involving development of shallow ponds and processing facilities on 40 acres of former pineapple plantation land in Wahiawa.

The demonstration project is planned by Ohio-based energy company Phycal LLC, which has leased the land and is preparing an environmental assessment.

Phycal also has obtained more than \$3 million in federal grant financing, plus undisclosed private capital and a \$1 million matching grant from the state Department of Business, Economic Development and Tourism.

Ted Peck, state energy administrator with DBEDT, said Phycal's pilot—if executed as planned—will help determine whether algae is a feasible crop for large-scale energy production in Hawaii.

"It's not yet proven, but it's certainly worth our time and investment because the upside is so significant for the state," Peck said. "It'd be imprudent for us not to invest in it. We're excited. The next five years are potentially a transformative time for Hawaii's liquid fuel market and agriculture."

Initiatives like Phycal's and other plans for alternate forms of renewable energy production could help the state achieve its ambitious goal of obtaining 70 percent of its energy from clean, renewable sources by 2030.

Phycal is one of several companies exploring algae as a commercial source for biofuel in Hawaii but is one of the leaders in terms of trying to prove the concept.

Others include HR BioPetroleum Inc., a company partnering with Royal Dutch Shell Plc on a 5-acre test project on the Big Island, General Atomics on Kauai and consortium Hawai'i BioEnergy.

Plant oil extracted from algae can be refined to produce diesel or jet fuel and also can be used to fuel power plant turbines for electricity generation. An additional byproduct is a light petroleum gas that can be used to make hydrogen fuel.

Phycal plans to produce algal oil by growing microalgae in shallow open pools. The water for the ponds is to be reclaimed waste water fed from a sewage treatment plant. Another key ingredient needed to grow algae, carbon dioxide, will be trucked from Tesoro's Oahu refinery, which produces CO₂ as waste.

After growing and storing up oil, algae are processed to extract the oil. So far, typical processes for producing algal oil have not been economically feasible, though Phycal believes it has proprietary, patented technology that can produce biofuel at market-competitive prices for Hawaii.



Among the company's partners are GE Global Research and the NASA Glenn Research Center. Local design firm Group 70 International is also involved.

Kevin Berner, Phycal's president, said the expectation is that the pilot project will run four years, with an initial phase producing more than 100,000 gallons of algal oil a year.

"The trick is how do you grow algae at the right cost point," he said. "That's the hard part and

that's what we're working on."

Part of Phycal's pilot involves a testing lab in St. Louis for algae strain work, and a subpilot facility in Cleveland.

If permits can be obtained without unexpected delay, construction could begin on the Hawaii component as soon as October or early next year.

Berner said that if the pilot is successful at producing algal oil cost-effectively, then a commercial-scale operation could be developed in Hawaii using several thousand acres of flat, low-grade farmland with access to reclaimed water and a pipeline to a CO₂ source.

Of course, Phycal's plan is to some extent theoretical, and Berner is careful to emphasize that the company's work is still in a development stage despite years of study.

The fledgling U.S. industry aiming to produce algal oil for fuel has had some high-profile flameouts, and some scientists regard typical industry projections as spectacular.

"There is a lot of skepticism," said Peck, of DBEDT. "Algae is still an under-development technology."

Michael Cooney, a professor and researcher with expertise in biofuels at the University of Hawaii's School of Ocean and Earth Science and Technology, said early-generation algae biofuel companies overhyped the industry to a large degree.

Cooney said he believes there is a niche for algae biofuel in Hawaii given high fossil fuel energy costs and abundant sources of sunlight, flat vacant farmland and reclaimed water sources, though he is still skeptical about how economically feasible commercial production will prove to be and how much of an advantage algae holds over competing biofuel crops.

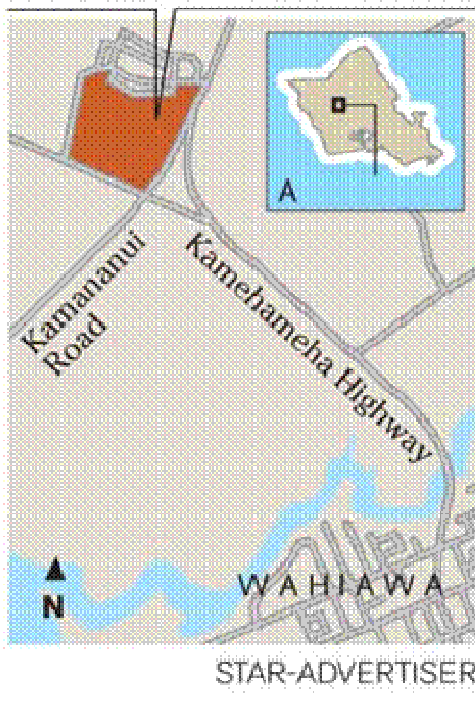
"It's unproven, and it's very difficult to scale up," he said.

Hawaiian Electric Co., which issued a request for proposals in March from biofuel producers, cites yield estimates for algae of 1,000 to 15,000 gallons per acre annually, compared with 640 gallons per acre annually for palm oil, 200 for jatropha and 50 for soybeans.

HECO estimates algae needs 33 percent or less land for biofuel production compared with other leading crops.

Cooney believes industry yield estimates aren't practically achievable, though Phycal's pilot project will be a good demonstration as to what can be achieved. Cooney added that he thinks Phycal, while more conservative in its expectations, might still be too optimistic.

PROPOSED SITE



Peck said his assessment of Phycal is that it is focused on underpromising and overdelivering. "I'm very encouraged about their approach," he said. "We're excited to see this pilot come about."

Many plants have good potential to become renewable sources of biofuel in Hawaii—palm, jatropha, soybean, sunflower—but one group, microalgae, is on track to soon undergo a pivotal test locally.

The test is a \$65 million pilot project involving development of shallow ponds and processing facilities on 40 acres of former pineapple plantation land in Wahiawa.

The demonstration project is planned by Ohio-based energy company Phycal LLC, which has leased the land and is preparing an environmental assessment.

Phycal also has obtained more than \$3 million in federal grant financing, plus undisclosed private capital and a \$1 million matching grant from the state Department of Business, Economic Development and Tourism.

Ted Peck, state energy administrator with DBEDT, said Phycal's pilot—if executed as planned—will help determine whether algae is a feasible crop for large-scale energy production in Hawaii.

"It's not yet proven, but it's certainly worth our time and investment because the upside is so significant for the state," Peck said. "It'd be imprudent for us not to invest in it. We're excited. The next five years are potentially a transformative time for Hawaii's liquid fuel market and agriculture."

Initiatives like Phycal's and other plans for alternate forms of renewable energy production could help the state achieve its ambitious goal of obtaining 70 percent of its energy from clean, renewable sources by 2030.

Phycal is one of several companies exploring algae as a commercial source for biofuel in Hawaii but is one of the leaders in terms of trying to prove the concept.

Others include HR BioPetroleum Inc., a company partnering with Royal Dutch Shell Plc on a 5-acre test project on the Big Island, General Atomics on Kauai and consortium Hawai'i BioEnergy.

Plant oil extracted from algae can be refined to produce diesel or jet fuel and also can be used to fuel power plant turbines for electricity generation. An additional byproduct is a light petroleum gas that can be used to make hydrogen fuel.

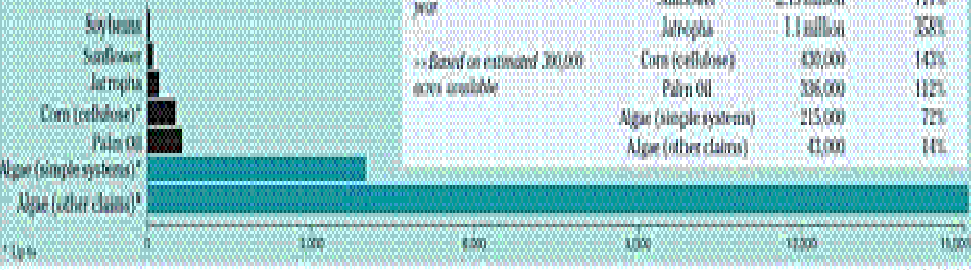
Phycal plans to produce algal oil by growing microalgae in shallow open pools. The water for the ponds is to be reclaimed waste water fed from a sewage treatment plant. Another key ingredient needed to grow algae, carbon dioxide, will be trucked from Tesoro's Oahu refinery, which produces CO₂ as waste.

After growing and storing up oil, algae are processed to extract the oil. So far, typical processes for producing algal oil have not been economically feasible, though Phycal believes it has proprietary, patented technology that can produce biofuel at market-competitive prices for Hawaii.

Among the company's partners are GE Global Research and the NASA Glenn Research Center. Local design firm Group 70 International is also involved.

BIOFUEL CROP-YIELD ESTIMATES

Crop or feedstock (gallons/acre/year)



LAND REQUIREMENTS

Requirements by crop to yield 215 million gallons of biofuel per year

| Crop or feedstock | Acres | % of nation's cropland |
|------------------------|--------------|------------------------|
| Soybeans | 4.1 million | 1.43% |
| Sunflower | 2.15 million | 0.77% |
| Jatropha | 1.1 million | 0.38% |
| Corn (cellulose) | 420,000 | 0.14% |
| Palm Oil | 336,000 | 0.12% |
| Algae (simple systems) | 215,000 | 0.07% |
| Algae (other claims) | 41,000 | 0.01% |

Based on an estimated 300,000 acres available

Kevin Berner, Phycal's president, said the expectation is that the pilot project will run four years, with an initial phase producing more than 100,000 gallons of algal oil a year.

"The trick is how do you grow algae at the right

cost point," he said. "That's the hard part and that's what we're working on."

Part of Phycal's pilot involves a testing lab in St. Louis for algae strain work, and a subplot facility in Cleveland.

If permits can be obtained without unexpected delay, construction could begin on the Hawaii component as soon as October or early next year.

Berner said that if the pilot is successful at producing algal oil cost-effectively, then a commercial-scale operation could be developed in Hawaii using several thousand acres of flat, low-grade farmland with access to reclaimed water and a pipeline to a CO2 source.

Of course, Phycal's plan is to some extent theoretical, and Berner is careful to emphasize that the company's work is still in a development stage despite years of study.

The fledgling U.S. industry aiming to produce algal oil for fuel has had some high-profile flameouts, and some scientists regard typical industry projections as spectacular.

"There is a lot of skepticism," said Peck, of DBEDT. "Algae is still an under-development technology."

Michael Cooney, a professor and researcher with expertise in biofuels at the University of Hawaii's School of Ocean and Earth Science and Technology, said early-generation algae biofuel companies overhyped the industry to a large degree.

Cooney said he believes there is a niche for algae biofuel in Hawaii given high fossil fuel energy costs and abundant sources of sunlight, flat vacant farmland and reclaimed water sources, though he is still skeptical about how economically feasible commercial production will prove to be and how much of an advantage algae holds over competing biofuel crops.

"It's unproven, and it's very difficult to scale up," he said.

Hawaiian Electric Co., which issued a request for proposals in March from biofuel producers, cites yield estimates for algae of 1,000 to 15,000 gallons per acre annually, compared with 640 gallons per acre annually for palm oil, 200 for jatropha and 50 for soybeans.

HECO estimates algae needs 33 percent or less land for biofuel production compared with other leading crops.

Cooney believes industry yield estimates aren't practically achievable, though Phycal's pilot project will be a good demonstration as to what can be achieved. Cooney added that he thinks Phycal, while more conservative in its expectations, might still be too optimistic.

Peck said his assessment of Phycal is that it is focused on underpromising and overdelivering. "I'm very encouraged about their approach," he said. "We're excited to see this pilot come about."