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## **Power Lunch: Bacteria turn leftovers to energy**

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With the help of billions of hungry bacteria, a University of California, Davis, engineer has cooked up a system to extract energy from table scraps.

At a ceremony today expected to draw hundreds of people, the campus will formally introduce its \$1 million "biogas" plant.

The plant can swallow between eight and 10 tons of food waste a day, feeding tanks of microbes that, in turn, excrete hydrogen and methane -- gases that can be burned to generate electricity or fuel vehicles.

"This is a real commercial-size system," said Ruihong Zhang, the UC Davis professor of biological and agricultural engineering who invented and patented the system after eight years of tinkering.

"This is 20,000 times larger than what we've been working with in the laboratory," she said.

At full capacity, the plant can produce enough electricity for 10 average California households a day, said Dave Konwinski, chief executive officer of Onsite Power Systems Inc., a company that developed the system in partnership with Zhang.

Konwinski put \$750,000 into the demonstration project. Zhang contributed \$250,000 from a \$1 million research grant she received from the California Energy Commission.

Onsite Power Systems Inc. relocated from Southern California to Davis a year and a half ago to devote all its efforts to the new system, known to engineers as "advanced anaerobic digestion."

"Anaerobic" refers to the type of bacteria employed, bacteria usually found in swamps, thriving in oxygen-free environments.

"Digestion" is what happens as the bacteria decompose foods and other organic matter.

Konwinski hopes restaurants, institutions and others in the food business will see value in diverting waste from the landfill, using it instead to produce energy. A system of \$1 million or so can pay for itself in three to five years, he said.

He has a number of prospective clients in mind. "Many have been sitting on the sidelines, waiting to see it run," he said.

The demonstration plant consists of five 10,000-gallon tanks that hold the bacteria, their feed and the gas. On Monday, the system had been running for about a week, and most of the tanks were filled with a black soup.

The system is sealed, so it's not supposed to give off any stink, although Zhang and Konwinski did at one point catch a whiff of hydrogen sulfide -- a rotten-egg smell -- from the catwalk above the tanks.

For all its potential odors, the plant will not stand out among its neighbors; it shares space with the UC Davis wastewater treatment plant south of the campus core.

Konwinski said the whole operation is automated and equipped with wireless communications. Only one person is required on site once a week to shovel food wastes onto a conveyor belt.

The bugs produce 10 times the amount of gas needed to power the system, Konwinski said; surplus goes onto the campus electric grid. He and Zhang said they plan to explore the possibility of storing some energy as compressed natural gas to fuel vehicles.

One thing about the biogas project that's not environmentally friendly: The food scraps are trucked in all the way from Bay Area restaurants.

That's because the waste is supplied by Norcal Waste Systems of San Francisco, which already collects restaurant leftovers for its composting operation near Vacaville.

"This is just for testing and demonstration," said Zhang, acknowledging the fuel-inefficiency of bringing food scraps from 70 miles away.

"For a commercial operation, this should not be in Davis, it should be in the Bay Area," she said.

One of Zhang's projects is working with the Sacramento Municipal Utility District to identify businesses and institutions that may wish to convert food waste into energy, either on their premises or on some centralized, yet-to-be-identified site.

Ruth MacDougall, a SMUD manager running the agency's "Leftovers to Lights" program, said 45 businesses that responded to a survey were found to produce enough food waste to power as many as 4,100 homes a year.

But harnessing that potential energy is not a quick process. One question that's come up is whether having a biogas digester is equivalent to running a solid-waste operation, which requires a permit.

"That's the thing with cutting edge," MacDougall said. "It hasn't been tried before. Nobody's asked that question before. And we're dealing with a few bureaucracies."