

ROCHESTER BUSINESS JOURNAL

VOLUME 18, NUMBER 35

DAILY EDITION: <http://www.rbjdaily.com>

DECEMBER 6, 2002

Genencor plays key role in cutting use of foreign oil

By SMRITI JACOB

Genencor International Inc.'s Rochester operations are expected to play a vital role in efforts to reduce the nation's dependency on foreign oil.

Genencor is in the third year of a program that supports an economically viable enzymatic process to convert cellulose material found in plant residue to ethanol. The biotech firm late last month reported progress on a \$17 million Department of Energy contract.

Managed through the department's National Renewable Energy Laboratory, the three-year contract calls on Genencor to assist in the development of sustainable biorefineries. These refineries hold the potential to produce biofuels and biochemicals.

The firm's local operations are expected to participate in the commercialization phase of the project.

"Right now, Rochester's role is limited. As the program moves toward commercialization, one would expect Rochester to have a role and I could see it happening as early as next year," said Thomas Pekich, group vice president of bioproducts.

Genencor develops genetically based biotech products for the health care, agriculture and industrial chemicals markets. It employs some 200 people here.

For the NREL project, Genencor researchers are developing new enzyme systems for the economic conversion of plant matter or biomass into fuel ethanol and other materials. The Energy Department has determined the cost of converting biomass into usable form is a huge stumbling block to producing ethanol and other biochemicals.

Some \$80 million worth of enzymes are used to produce 1 billion gallons of fuel ethanol.

"Bringing down the cost of the enzymes was identified as a top priority. Genencor is a real player in that industry," said James McMillan, senior biochemical engineer and NREL project leader for the biofuels program in Colorado.

Genencor's task is to bring about a tenfold cost reduction for the process, in which enzymes play an important role. The company's first milestone in the project brought the cost down 2.3 times.

"We are significantly beyond that now. The ultimate milestone is to improve the cost structure," said William Dean, vice president for process science and NREL project leader for Genencor.

The demand for ethanol is expected to increase by more than 3 billion gallons by 2010, a life sciences merchant bank Burrill & Co. report shows. The demand for ethanol could result in a total improvement of \$2.5 billion in the nation's trade balance from 2004 to 2010, Burrill experts report.

Oil imports account for almost one-third of the U.S. trade deficit. In 2000, the United States imported \$106 billion of crude oil and petroleum products, up 63 percent from \$65 billion in 1999, a U.S. Census Bureau report states.

"The world transportation market for fuel is 500 billion gallons," Pekich said. "If you could take a percentage of that and use it toward biofuels, it would reduce dependency on foreign oil, make the environment a lot cleaner and improve incomes for farmers."

Using ethanol as a motor fuel is not a new phenomenon. Henry Ford in 1907 introduced the idea by producing the first vehicle to run on ethanol. But America's ability to refine crude oil into gasoline shifted attention from ethanol. The product regained ground as a fuel extender in the 1970s and in the years that followed, ethanol was used to remove lead from gasoline.

Ethanol's use continues to grow. The ethanol industry is valued at \$2.5 billion, the Burrill report shows.

"The government's goal is to be competitive with a barrel of oil and get the process to be cost-effective," Pekich said. "At the end of the day, you would drive up to a gasoline pump and the gasoline would have 10 to 15 percent ethanol, made from Genencor enzymes."

Cornstalks commonly are used as the primary source for ethanol. Despite the abundance of cellulases or enzymes used to degrade cellulose, it has been challenging for scientists to find the appropriate mix of enzymes. Cellulose present within the stalks is required to be broken down into simpler forms to result in ethanol production.

"Cellulose is a structural polymer and it forms a tough package," Genencor's Dean said. "People have been trying for 60 years

to break down cellulose."

Genencor's enzyme system attempts to make the process efficient, by genetically engineering the suite of cellulase enzymes to break down the biomass material and complex carbohydrates into fermentable sugars. These sugars are the raw materials necessary for future biorefineries to produce ethanol, organic chemicals and other bioproducts.

"The largest cost in the whole (ethanol production) process is the cost of the sugar itself," Dean said. "The long-term view is to do work on lowering the cost of carbon, which will lower the cost of the overall process."

Some 25 Genencor employees in California and its Leiden offices in the Netherlands work on the effort.

"The NREL project is the largest single project in the last two years for the company," Dean said. "Out of 200 R&D employees, 25 work on NREL and that is a huge chunk."

The firm has deployed a three-pronged strategy that includes the fermentation and recovery of the enzymes, improvement in enzyme production in a microorganism and alteration of the suite of enzymes to improve its capacity to attack cellulose.

"We (also) need to lower the amount of enzyme needed to make a gallon of ethanol," Dean said.

In addition to reducing the cost of the process for NREL, Genencor independently can pursue related market opportunities.

"The company can get it out in the marketplace," NREL's McMillan said.

The company is studying the business potential, Pekich said.

"We are still exploring business opportunities," he added. "One can envision us manufacturing the enzymes (and) licensing the technology or we might go further down the value chain and be a player."

Genencor competes with Novozymes Biotech Inc., a U.S. subsidiary of Novozymes A/S for the same project. The Energy Department last year awarded Novozymes a three-year \$14.8 million contract.

"It is a big project with big potential so competition is healthy," Pekich said.

Genencor has extensive experience with enzymes. The firm worked with E.I. du Pont de Nemours and Co. to create 1,3

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propanediol, the starting material for DuPont's new Sorona biopolymer, which is on its way to market. Genencor's contribution to the project resulted in a 500-

fold increase in process efficiency.

Another bioproducts contract for Genencor is its \$70 million supply agreement with Cargill Inc. The company exclusively will supply Cargill with all biocatalysts for its wet corn-milling facilities in the

United States over a five-year period.

Genencor expects to report further progress in the areas of silicon biotechnology, personal care and emerging markets such as agriculture within the next six to 12 months.

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