fuel speed ahead

"We're not in the 'hype and hope' group," says Emil Jacobs. "We have a very realistic view of the work that needs to be done to make this a commercial success."

Jacobs, vice president of research and development at Clinton, N.J.–based ExxonMobil Research and Engineering Co., is referring to the possibility of making an oil-like fuel from algae. Last July, ExxonMobil announced it would invest $600 million in algae-biofuel research, in partnership with Synthetic Genomics Inc. (SGI) in San Diego. It's ExxonMobil's largest single investment in renewable energy to date.

ExxonMobil's **Emil Jacobs** examines algae as a potential supplement for crude oil

Algae are among the most photosynthetically efficient plants on earth, and the biofuel made from algae has a molecular structure similar to petroleum. The plants store solar energy in the form of carbohydrates, proteins, and oils. The more efficient the plant at converting solar energy into chemical energy, the better its potential from a biofuel perspective.

Jacobs is the point man for ExxonMobil's algae-based biofuel initiative. Since joining the company in 1978 after earning a PhD in chemical engineering from Princeton, his career has been split almost evenly among research and engineering, marketing, and business unit management. He says the myriad roles prepared him well for his current job, which requires him to balance scientific acumen with real-world business practicality. Jacobs and his cross-functional team at ExxonMobil — including chemists and experts in technology, planning, and economics — are focused on evaluating biofuels objectively, without rose-colored glasses.

In 2007, Jacobs' team began assessing biofuel options in relation to four key parameters: scalability, technical challenges, environmental performance, and economics. Every option also had to produce sufficient energy. "We looked at each of the options and said, 'Here are the technical challenges. What capabilities do we bring to address those challenges?'" he explains.

The decision-making process was aided by ExxonMobil's fuel products group,

By Eric Tegler

Photographs by Peter Murphy

whose members weighed the compatibility of biofuels with extant fuels like diesel, gasoline, and jet fuel. Evaluations were shared with senior executives at the company. "As we sifted through the options," Jacobs says, "biofuel from algae rose to the top."

According to Jacobs, photosynthetic algae offer several advantages over other biofuel alternatives. For example, unlike sugarcane, corn, or soy, algae can be grown using land and water that are unsuitable for plant or food production. Algae also consume carbon dioxide, which provides greenhouse gas mitigation. Even more important, algae have a higher potential bio-oil yield per acre than other alternatives. "We easily see algae-based [production] yielding 2,000 gallons per acre per year," Jacobs asserts, versus 50 to 650 gallons for soy, corn, and sugarcane.

What's more, algae are very productive. "Algae can be grown in a couple of days," Jacobs points out. "As a result, the process of testing different strains and their fuel-making potential can be done faster than if you're using other crops whose growing time may be a season."

ExxonMobil's partner, SGI, is responsible for assessing the various strains. Co-founded by Craig Venter, a driving force in the project of sequencing the human genome, SGI underwent a rigorous evaluation process. "Obviously, this is not an area of technology that we are deep into," Jacobs acknowledges. "So we got approval to look at who would be best to collaborate with. We threw the net pretty doggone wide."

> Algae have a higher potential bio-oil yield per acre than any other alternatives.

Jacobs' team considered universities, public companies, and private companies, eventually compiling a list of about 20 prospects before finally choosing SGI. "Their world-class capabilities in genomics and synthetic biology matched up extremely well with ExxonMobil's engineering, process, and project management capabilities and overall knowledge of the energy industry," Jacobs says. "I think we have a great collaboration."

SGI is building a new test facility in San Diego to study algae-growing methods and oil extraction techniques. Testing to determine which production method works best (for example, open pond, closed pond, or photobioreactor) will be carried out by integrated ExxonMobil/SGI teams. Each company will take the lead where it has the most relevant capabilities, Jacobs notes.

Both Jacobs and Venter admit there is some uncertainty whether algae-based biofuels will prove commercially viable, so they're taking a step-by-step approach. "I think we're [looking at] a five- to 10-year time frame before we're [ready for] a good-size demonstration of the process, something one step away from a commercial demonstration," Jacobs says.

When such a demonstration does go forward, it will likely include an evaluation of algae-based biofuel as a jet fuel substitute, an option that Continental Airlines has been exploring since January 2009, when it tested a biofuel blend in one of its twin-engine passenger jets (see story, page 91). Jacobs says that if demonstrations prove successful, ExxonMobil will ultimately tailor its algae-based products to whatever end uses they best fit, including jet fuel.

The algae-biofuel initiative, Jacobs says, is emblematic of a major change he's seen at ExxonMobil since he joined the company. "One thing we've changed over the years is our ability to look outside and bring new ideas to ExxonMobil and either collaborate or build on the ideas of others," he says. "I think this is a very good example of that."

ALTERNATE ROUTE

Beyond Biofuel

ExxonMobil is actively assessing and pursuing other energy alternatives in addition to algae-based biofuel. Developing lightweight automobile plastics and more efficient engine oil, for example, could ultimately translate to a savings of approximately 5 billion gallons of gasoline a year, equivalent to taking about 8 million cars off the road.

But the company is going even further, working on new technologies, such as carbon capture and storage (CCS), to further reduce emissions. ExxonMobil is involved in a CCS project in the North Sea in which CO_2 is separated from natural gas produced by offshore wells and reinjected into a saline aquifer. More than 10 million metric tons of CO_2 have been safely stored underground as part of the project. The company is also a participant in the Gorgon Project in Australia, helping to build the world's largest commercial-scale CCS facility. — *E.T.*