If Algenol gets the grant, it will construct a pilot plant with Dow at Dow's manufacturing site in Freeport, Texas, with the goal of capturing industrial carbon dioxide and producing alga-derived ethanol to generate ethylene, a building block for plastics.

Meanwhile, Sapphire Energy has garnered more than $100 million from bigwig investors, including Gates's Cascade Investments and the Rockefeller family's venture-capital firm Venrock. Sapphire is using genetic engineering to boost several algal traits, including improved protection from predators and low-cost harvestability. It is also working to genetically manipulate the algae to produce oils that are nearly identical to crude oil as extracted from the ground.

And Solazyme's contract with the Navy is the first contract anywhere to manufacture commercial-scale quantities of next-generation biofuels. The contract requires that Solazyme deliver some 75,000 litres of F-76 renewable fuel, which is similar in composition to diesel fuel, over the next year. "This really raises the bar in what constitutes a true production capability versus an interesting research direction," says Dillon.

Still, many challenges remain. In May GreenFuel Technologies, a front-runner on the algal scene that had amassed some $70 million in investments since 2001, announced that it was closing down. Sam Jaffe, an energy analyst with IDC Energy Insights, a research and analysis firm based in Framingham, Massachusetts, says that GreenFuel pursued too many different technologies, including expensive greenhouses to control algal growth conditions. "Growing algae is easy," says Jaffe. "Growing it as a business and making money off of it is about getting the costs down."

One of the biggest challenges is to reproduce laboratory conditions on a large scale. In the lab, it can be easier to control algal growth and to find strains that produce copious amounts of oil. "But it's a totally different story when you take this organism that behaves well in the laboratory and you put it in acres' worth of outdoor ponds," says Darzins. For this reason, some companies have opted to grow their algae in enclosed 'bioreactors'. But the costs of building bioreactors can be prohibitively expensive. The algae community is "still torn" between open ponds and closed bioreactors, Darzins says.

With so much enthusiasm and investor interest in algal technology, new companies have sprung up almost overnight. Some experts say that because much of the science behind these technologies is not peer reviewed and is done through privately held companies, it can be difficult to gauge their progress. "On the one hand you get their hype, and on the other hand they're guarding everything so closely that you can't evaluate it," says Martha Groom, a conservation biologist at the University of Washington in Bothell. "I find that fairly frustrating."

Experts say that a few companies have made questionable assertions about how much fuel they can reap from their algae. "Unfortunately, a lot of people tout these technologies and yet don't have the production data to back it up," says Doug Henston, chief executive of Solix Biofuels, a renewable-energy company based in Fort Collins, Colorado, that opened an algal oil-production demonstration facility in July at a coal-bed methane plant in southwestern Colorado. "That's the unfortunate case because it clouds the picture and builds unrealistic expectations," he says. Solix hopes to push its production capacity from its current rate of about 14,000 litres per hectare per year to between 37,000 and 47,000 litres per hectare per year. However, some start-ups have claimed that they can reach oil-production capacities as high as 900,000 litres per hectare per year, which, says Henston, is "thermodynamically impossible".

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Fuel source of the future?

Dillon, of Solazyme, says that the recent involvement by big-league investors, oil giants and the US military will help sort out approaches that are leading somewhere from those that aren't. "I think it's a good thing that we've got some real expectations coming on," he says. "There's been a lot of hype. That has a time window on it, and that type of time window tends to close when major players with real expectations start getting involved." ■

Amanda Leigh Mascarelli

NEXT WEEK: CELLULOSIC ETHANOL

Correction

The Editorial 'Data's shameful neglect' (*Nature* 461, 145; 2009) stated that the Joint Information Systems Committee was established by the seven UK research councils. It was, in fact, established by the three Higher Education Funding Councils.