

## Researchers hail algae as fuel of the future

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Algae being grown as part of Arizona Public Service's Emissions-to- Biofuels Project in 2007 at Redhawk Power Station, 55 miles west of Phoenix.

From the peak of Mount Everest to 600 feet below the polar ice caps, algae can be found everywhere. The plant-like organisms come in many sizes, from microscopic and single-celled all the way up to complex, such as seaweed.

And research is being conducted now that may allow these diverse organisms to be used for something even more complex - a major, clean power source for the industrialized world.

Researchers in academia and the business sector in Arizona and around the globe are looking at algae as not only sources of biofuel, but also as cleaners for other energy production sources.

Milton Sommerfeld, a professor of applied sciences and mathematics, works with algae at Arizona State University. His work ranges from discerning the growth rates of various algae strains in small batches in his lab to large-scale cultivation of algae outdoors.

The professor, who has taught at ASU for more than four decades, cites myriad reasons for large-scale development and use of algae to meet the state's energy needs.

"People realized that our petroleum supplies are finite," Sommerfeld says. "We need to look at some alternatives. We need to look at green technologies."

Algae, as a source of biofuel, qualify as a renewable and reusable energy source. "If you burn fuel from the algae it's going to be fuel that took up (carbon) out of the atmosphere in the first place, so you're simply recycling that, rather than taking something that's already stored in the ground and now releasing it into the atmosphere," Sommerfeld says.

Some algae are able to reproduce in one day, which is speedy, and some strains have another unique and valuable characteristic. "People recognized many years ago that the

algae were organisms that would grow fast, and they also could accumulate oil in their cells,” he says.

This oil production, which Sommerfeld says can be up to 40 percent in some strains, makes algae viable as a fuel source on its own. These characteristics, combined with the planet’s limited sources of fossil fuels, have led to a resurgence in algae research during the past five years.

Also, algae can grow in virtually any kind of water, like gray water. Arizona has large underground aquifers that can’t be used for other purposes, but could be used to grow the organisms. “It’s not about taking good water that we could use for something else,” he says. “The algae are not particular in the water that is used, so we use waste water.”

Sommerfeld says although algae are a viable option to replace petroleum-based fuels on a large scale, roadblocks remain.

“There are a number of hurdles that we have to get over, and obviously one of the more important hurdles is the fact that we have to (make algae biofuel) in a cost-effective manner,” Sommerfeld says. “We have to be able to do it in a way that the oil formality is competitive with other sources of petroleum.”

Glen Galster, president and co-founder of Algae Biosciences based in Holbrook, firmly believes in algae biofuel, but agrees that for it to become widely used, the price must first become competitive with equitable petroleum-based products.

“You could call biodiesel from algae a neat fuel,” he says. “It has very superior characteristics to petroleum-based diesel. (Adding) as little as 5 percent into our current petroleum-based diesel could dramatically decrease the amount of pollutants going into the atmosphere.”

Galster, whose company focuses on producing “high-value” products from saltwater algae, says algae-based diesel may be a realistic energy source in five years, but it costs about \$30 more per gallon than petroleum-based diesel does now.

“There’s not much of a market for...biodiesel when you can buy diesel for \$3 and some change,” he says. “Every gallon you produce you’d be losing money.”

Algae Biosciences has methods of producing algae that will allow the company to produce quantities of algae so large in the future that they will exceed the supply necessary for their customers, says Galster. “At that point in time, when there are millions of metric tons being produced perhaps monthly, that’s the point where it makes sense (to go into biofuels) because we have all this huge amount of biomass, and we can utilize that for biofuels,” he says.

Galster says aside from price, another constraint to mass-production of algae as a biofuel is that politicians in Washington D.C. don’t realize that petroleum diesel needs a replacement.

“For people in the industry and people in academia, they understand,” he says. “People in the oil industry understand there needs to be a viable alternative, but the policymakers in Washington have not gotten the message yet.”

He would like to see an investment in algae on par with what is being spent on ethanol and research in finding alternatives for petroleum-based fuel.

“I believe algae could be commercialized if they’d spend even a fraction of what they’re spending on those projects,” he says. “They’re not economically viable. They need to spend some money on something that’s really going to do the job in the future.”

Arizona Public Service (APS), is researching algae on several fronts.

Steven Gottfried, an APS spokesman, says the company received more than \$70 million in stimulus money for a research-and-development project that will combine coal and algae in a process called hydrogasification to create a substitute natural gas, while also using the carbon-dioxide emissions to grow algae and create biofuels.

“It’s an entire integrated system that is designed to reduce the amount of carbon dioxide emitted from using coal at a power plant,” he says. “We’re going to try and feed that carbon dioxide to algae. It’ll be like giving the algae fertilizer.”

Gottfried says the United States has 250 years worth of coal in reserves, so the goal of the project is to continue to keep coal a viable source for electricity by creating a sustainable system.

“Coal’s a very inexpensive domestic source of energy that has some challenges,” he says. “If we can overcome the CO<sub>2</sub> emissions, it keeps coal a viable option.”

Gottfried says the focus of the project is on the coal, but it’s the algae that can make the process environmentally friendly. “We believe in a sustainable energy future in Arizona, and part of a sustainable energy future is being able to provide affordable, reliable electricity with the least amount of environmental impact as possible,” he says. “We look at algae as one of those ways that can do that.”

Galster, of Algae Biosciences, also remains optimistic about algae and its place in the future.

“The impossible situations are life without petroleum-based fuels,” he says. “The great opportunities are ways of finding alternatives to that, and I believe that the best alternative to petroleum-based fuels for the future will be algae..”