***Is Algae the New Corn – Biofuel Altneratives***

***by Julia Verdi***

In the past, corn has been the most popular feedstock for biofuel. However, with the food vs. fuel argument and the recent [2008 study arguing corn based ethanol](http://online.wsj.com/article/SB120241324358751455.html?mod=todays_us_page_one) may nearly double greenhouse gas emissions instead of reducing them, ethanol’s popularity may start to fade. So, if corn-based ethanol falls through, what will happen? Will we continue to pursue biofuel in general? And, if so, what kind of feedstock are we going to use?

I believe that biofuel, combined with wind and solar, is a much needed resource in the United States, especially in the transportation sector. In order for the US to have a secure energy future, a cleaner, more efficient biofuel needs to be made for our vehicles.  However, a cleaner and friendlier feedstock than corn must be used for this biofuel, and algae, may very well be the answer.

*So, why algae instead of corn?*

**1) Algae doesn’t need fresh water or land to grow:**

Like corn, algae uses sunlight and water to grow. However, unlike corn, which needs to be grown on land that could produce food and needs fresh water, many algae species that grow oil-producing lipids that we need in order to make biofuel, can grow in brackish, salty water.  Therefore, algae would not compete with land that can be used for food or even use fresh water, like corn grown for ethanol does.

**2) Algae can reduce its impact on our environment and clean up our waste while it grows:**

Another reason algae may be superior to corn, is it actually requires CO2 to grow. So, while it is growing, it could potentially mitigate the  greenhouse gas emissions that it will create when it is turned into biofuel. [Algae also have the potential to actually clean up sewage while it grows](http://greeneconomypost.com/nasa-algae-sewage-biofuel-2702.htm), so ultimately we could decrease the impact of biofuel in our atmosphere, find a better way to throw out our sewage and grow a feedstock for biofuel all at the same time.

**3) Algae grows faster than corn:**

Algae is harvested multiple times a year, therefore, it has the potential to produce 1,200 gallons of biofuel per acre per year. One acre of corn can be processed into approximately 328 gallons of biofuel.

**4) Algae-based biofuel is denser:**

[Algae based biofuel has a high energy density per acre than any other feedstock for biofuel](http://www.triplepundit.com/2008/10/biofuels-from-algae-dr-richard-sayre-separates-the-promise-from-the-hype/).  Because of this high energy density, a higher amount of algae based biofuel will be able to be used in motor vehicles than corn-based biofuel.

The benefits of algae-based biofuel far outweigh the benefits of corn-based biofuel. With algae, food and water will not be an issue, it is cleaner than corn-based biofuel, it grows faster and it will be more useful in vehicles.

However, One of the biggest problems with algal biodiesel is the high costs for implementing the technology.  David H Kurzman of Kurzman Cleantech L.P. said that as of 2009, “there is not yet a commercially viable algae approach”.  Luckily, there are no shortages of investors throughout the world who are looking to gain profits from companies working on developing a low cost business model that can scale up production to commercial levels.

Finding ways to reduce costs associated with every aspect of algal biodiesel production is essential.  There are fixed costs from the project’s inception starting with the construction of ponds, as well as the ongoing operational costs of culturing the algae species, providing nutrient and energy inputs, isolating the bio oil, and the conversion to a usable liquid fuel.  There are other ways to reduce overall costs by selling “waste” products of the Companies also hope to squeeze capital gains out of the process by turning the biomass remaining into animal feed or ethanol.  In order for algal biodiesel to have success in the future, it is important that the costs are reduced so that it is able to compete in an open market with similar liquid fuels.

5) Another limitation that will need to be overcome before algal biodiesel can be considered a successful commercial technology is identifying a steady and reliable source of carbon dioxide.  Every 1 unit of algal biomass produced requires twice that amount in carbon dioxide in order to sustain commercially viable productivity levels.  Ambient absorption of atmospheric carbon dioxide would not be sufficient to sustain commercially viable algal production, despite concerns about its increased concentration over the past couple of hundred years (i.e., greenhouse gas effect).  This means that concentrated sources of carbon dioxide must be delivered to the algae diesel production site from fixed and mobile vehicle point sources.  One source could be captured carbon dioxide emissions from the stacks of coal-fired power plants.  Coal-fired power plants are obviously major sources of carbon dioxide, but how can you capture it efficiently and cost-effectively?  Again, companies are working on low-cost solutions, but a perfect solution has yet to be discovered.

6) There are also reservations regarding the control, or lack thereof, of factors related to production of algal biodiesel.  Weather changes, exposure to biological agents in the atmosphere and solar irradiation have the potential to significantly disrupt production.  These often unforeseen factors are difficult to plan for when operating an algal bio oil production facility.  Climatic conditions also play an important role when determining the best locations for algal production sites.  Sunny and warm growing conditions are achieved in desert areas during the daytime are optimal for algal growth and bio oil production, however, the abrupt drop in temperatures at night are prohibitive to sustaining the best growth rates.

***Can vegetable-oil cars save the world?***

Used restaurant cooking oil is free, clean burning and can power your vehicle. So why aren't more people using it?

By Steve Hargreaves, CNNMoney.com staff writer

NEW YORK (CNNMoney.com) -- Gas is expensive. Old vegetable cooking oil from restaurants is free. A car can actually run on either. So why aren't more people ditching petroleum and running on peanut power?

"[Making the switch] couldn't be simpler," said Patrick Kuhn, who converted one of four trucks at his company, Charlotte Moving Truck Rentals, to run on vegetable oil earlier this year.

He said his customers love it and constantly choose the veggie-powered vehicle over his others."I never see that truck anymore," he said.

But while Kuhn's truck may be a hit, for many people life with a veggie car might not be so easy. And although this alternative fuel may be cheap and clean, there simply isn't enough of it to make a big dent in our gas consumption.

Kuhn said it cost $3,500 to convert the truck to veggie power, which can be done to any diesel engine. That includes adding a fuel tank in the back (which has a heating element inside it, because the oil needs to be kept hot to burn), fuel lines up to the engine, as well as a filter and a valve set and toggle switches so the driver can choose between running on vegetable oil or on conventional diesel fuel.

For the sake of convenience, he buys used restaurant cooking oil from a dealer about an hour away - the same guy, actually, who installed Kuhn's veggie fuel system.

Kuhn pays the supplier - who collects, filters and delivers the oil - about $1.50 a gallon. That compares to the $3 a gallon he said he'd pay for diesel.

"These trucks, they're not Honda Accords, they consume a lot of fuel," he said, "It pays for itself pretty quickly."

Kuhn is part of what Lee Briante, a spokesman for Greasecar, the largest purveyor of veggie fuel conversion kits, says is a growing market segment.

"In the first few years it was, I don't want to say hippies but...now it's folks doing it for the economy of it," said Briante.

Indeed, the economics of veggie oil are even better for a car than they are for a truck. Briante said the car conversion kit, available online and similar to Kuhn's system, costs about $800.

**Hold the fries**

The mechanically inclined can install the system themselves, or it can be installed at one of two dozen Greasecar-certified mechanics nationwide for another $600.

But Briante said that the government regulations requiring fuel sellers to be licensed would make it hard for most people to keep their veggie-cars fueled - few people would be lucky enough to have a guy nearby who can top off their tank the way Kuhn does.

Instead, many people fuel up by forming a relationship with a local restaurant, which leaves its old cooking oil out back in 5-gallon jugs for the user to collect. (Restaurants usually have to pay to get rid of this oil, so proprietors are often happy to do so.)

Another downside: Users have to strain the oil to clean out the old French fries and such, before they pour it into the tank.

"The infrastructure really isn't in place," said Briante. "My mom's not going to want to do it."

And since there just isn't that much vegetable oil available to power cars, it's unlikely that there will be ever be a push to build this infrastructure.

Briante said there are about 100 million gallons of waste restaurant oil generated annually. That would only replace about 0.07 percent of the 140 billion gallons of gas Americans use each year, and that's assuming everyone switched from gasoline to diesel engines. Using new vegetable oil - not the used stuff from restaurants -raises similar scarcity questions.

One environmental group, which declined to be identified, didn't have anyone to comment on the prospect of veggie oil reducing oil dependency or clearing up the air, calling it a "non-issue."

But that doesn't mean veggie cars won't get more popular or become easier to operate.

"With $3 diesel, I don't think it will take long before someone realizes 'hey, there's money to be made in this,'" said Kuhn.

**Questions**: Answer on Separate Sheet of Paper or Back

1. What does Julia Verdi believe will help solve our nation’s transportation issues?
2. Name three major reasons why microalgae are more ideal than corn to use as a form of biofuel. Give one sentence for each pro you have chosen.
3. How does the efficiency of oil production of microalgae compare to corn? How much biofuel could be produced by microalgae in one day? How does that compare to corn?
4. Give two cons for using microalgae as a form of biofuel. Give one sentence for each con you have chosen. Do you think the pros outweigh the cons? Why or why not?
5. In the second article, how is Kuhn obtaining his vegetable oil? How much does it cost? How does that compare to gas prices?
6. Why are restaurants happy to give up their oil to people who want it? What needs to be done to the oil before it can be poured into the gas tank? Why?
7. Give two reasons why you think that switching from oil to vegetable oil would not work, in terms of costs and availability. Give one sentence explanation for each con you have chosen.
8. How much did it cost Kuhn to install a fuel tank for vegetable oil? What type of fuel had Kuhn previously been using? Is this something you would do you to your car? Why or why not?