Information on Algae Based Energy in Conjunction with Coal Plant

First, what is Algae? They are a large and diverse group of simple, typically autotrophic organisms, ranging from unicellular to multicellular forms. An autotrophic organism produces complex organic compounds from simple inorganic molecules using energy from light or inorganic chemical reactions. They are the producers in a food chain. They take energy from the environment, in the form of sunlight or inorganic chemicals, and use it to create carbon-based organic molecules. All algae have photosynthetic machinery ultimately derived from the cyanobacteria, and so produce oxygen as a by-product of photosynthesis.

Under the right circumstances, algae turns out to be a dream feedstock for making liquid fuels. They are the fastest growing plants on earth; doubling their mass in a few hours. They are the most adaptable, thriving not only in cooling towers but also in sewage, boiling water, ice, Antartica, and the Dead Sea. They are the richest in high-energy oils ideal for making biodiesel; producing thirty times more vegetable oil per acre than sunflowers or rapeseed. They are rich in carbohydrates that can become ethanol and proteins for animal feed. They filter many air pollutants, neutralizing acids and splitting nitrogen oxides, precursors to smog, into harmless nitrogen and oxygen. Most important, they are the world's most efficient converters of carbon dioxide to oxygen and biomass. Algae have few higher-order functions: They don't need to leaf, flower, produce seeds, or bear fruit. All they do is consume carbon dioxide and divide. According to Ray Hobbs, who runs the Arizona Public Service's (APS) Future Fuels program, algae is "… photosynthetic life reduced to its essence."

There are a number of companies working with algae and they are listed at the end of this paper. One of the leaders is GreenFuel Technologies Corporation, based in Cambridge Massachusetts. Established in 2001, they created their first test of algae's ability to eat stack gases atop the roof of MIT's 20 megawatt cogeneration plant in 2004. It was a great success, removing 82 percent of the CO2 on sunny days and 50 percent when clouds were overhead. It cut the nitrogen oxide emissions by 85 percent 24/7.

The first challenge is finding the right algae. GreenFuel looks worldwide for indigenous varieties or saltwater species. Then adapt the algae by gradually shifting their living conditions, such as water supply, and chemical makeup of the gas to match those the algae will encounter inside the farm. The goal is having an algae that reproduces prolifically and crowds out any zooplankton or other algae that might try to move in. Other companies are working to genetically engineer the algae, but they do not considered this a good approach given the extensive time spent getting approval through the regulatory process.

The next challenge is configuring the bioreactors to allow the algae to get just the right amount of light. Too little is fatal, and too much also leads to the algae's doom. They have also found the algae needs to rest upon taking in the photon of light. GreenFuel has been developing different systems to address these requirements over the past seven years.

The potential yields from algae dwarfs those of any other biofuels crop. Unlike soybeans and corn, that can be harvested just once or twice a year, algae multiplies so fast they can be harvested daily. It is like milking a cow. While an acre of soybeans yields about 60 gallons of biofuels and oil palms about 600 gallons, an acre of algae could yield 5,000 gallons of biodiesel and ethanol a year. At present, only 20 percent of the US petroleum consumption is in the form of diesel. If half of the US cars ran on diesel, as they do in Europe, replacing all of it with soy diesel would require 1.5 billion acres of fertile land, three times the total cropland in the country. It could be done by using algae with 47 million acres of land not suited for agriculture. Although they require huge amounts of water, they can tolerate wastewater - and clean the power plant emissions as part of the process.

GreenFuel has used the Redhawk Power Plant, west of Pheonix, as a testing site for their technology. It is a 1060 MW Natural Gas Combined-Cycle plant, the cleanest of all fossil fuel power plants. GreenFuel's earlier bioreactor configuration absorbed 150 tons of CO2 per acre per year. In their newest version, the scaled up capacity would take up a ton of carbon per acre per day and then be converted to fuel. At that rate, a coal fired plant the size of Redhawk would require 2,000 acres of land for the greenhouse bioreactors to absorb half of the CO2 emitted. (Proposed DeYoung Plant capacity, 131 MW - 250 acres) When the fuel is burned, the carbon will be released to the atmosphere, but its energy will have been harvested twice, and it will have displaced an equivalent amount of fossil fuels.

The following are some of the host facilities for GreenFuel technology: APS Redhawk, AZ; MIT Cogen, MA; NRG Dunkirk, NY; Sunflower Electric, KS; NRG Big Cajun, LA; APS Four Corners, NM.

Other Algae Based Technology Companies: *

Solazyme
Blue Marble Energy
Inventure Chemical
Solena
Live Fuels
Solix Biofuels
Aurora Biofuels
Petro Sun
Bionavitas
Mighty Algae Biofuels
Seambiotic
Cellena
Origin Oil
UNH Biodiesel Group
Petro Algae
Blog: Oilgae.com

*See attachment for additional information and links to some of these companies.
Resource: *Earth: The Sequel* by Fred Krupp and Miriam Horn

David Trudell, 7/30/2008