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Paper #6 - Biofuels

# Green Dreams

In the modern era science has just begun to catch up with the need for alternative energies to reduce our dependance on fossil fuels. Biofuels are increasingly becoming viable alternatives to gasoline, diesel, and other non-renewable fuels, outlined in the *National Geographic* article entitled “Green Dreams”. As stated on the front page of the article, “Making fuel from crops could be good for the planet - after a breakthrough or two.” There are still many issues that must be dealt with before the production of biofuels is energy-efficient enough and yields enough supply for biofuels to have weight in the U.S. auto industry and a place at standard gas stations.

On the positive side, biofuels are renewable, substitute for gasoline and diesel fossil fuels, decrease dependence on foreign oil, increase rural economy, and decrease $CO_2$ emissions. Biofuels are criticized as potential replacements for fossil fuels because they currently come from food crops such as corn, soybeans, sugar cane, and canola. Additional concerns about biofuels seem justified given that 25,000 people die of hunger per day worldwide; that global food security is already at risk; that these monocultures require huge amounts of fossil fuels for production and harvest; and that wildlife habitat may be taken for marginal farmland to grow these crops.

Yellow field corn is currently used in the US to produce ethanol. Corn ethanol yields approximately 300-400 gallons per acre and releases 22% less greenhouse gas emissions than gasoline. Another possible positive of corn ethanol is that the increased costs of yellow field corn may force ranchers to raise cattle that is fed its original food, grass, and that is healthier for humans to eat since it will not have to be given so many hormones and antibiotics due to the problems of eating corn. On the other hand, there are many negatives associated with corn ethanol, not just limited to the ones listed for biofuels in general. Corn needs herbicides and nitrogen fertilizer and causes more soil erosion than any other plant. The production of ethanol uses fossil fuel and the process gives off $CO_2$ emissions--not carbon neutral as it emits more carbon than it displaces. If all of this is resolved, there is still no nationwide distribution system and hardly any infrastructure for biofuels in the United States. The problems of supply and efficiency persist as well: in 2006, the US production of ethanol was 4.86 billion gallons. That same year, ethanol production cost $1.09 a gallon. Ethanol vehicles get 30% less miles per gallon than gasoline-powered vehicles; thus in July 2007, the US retail price per gallon of gasoline was $3.03 and Ethanol 85 (a blend of 85% ethanol and 15% gasoline) was $2.62, but the cost to get an energy equivalent of a gallon of gas was $3.71.

Sugar cane is currently used predominantly in Brazil to produce cane ethanol and is already an integral part of their economy with 85% of their cars running on it. This type of ethanol yields approximately 600-800 million gallons an acre, which is twice that of corn ethanol. Cane ethanol generates 56% less greenhouse gas than gasoline. Partially because the stalk is already 20% sugar, cane takes less time to change into alcohol and is 8 times more energy efficient than corn. The Brazilians are "obsessed with efficiency" and currently get 7 harvests before replanting, burn waste cane for power in distilleries, and use waste water as fertilizer. The negatives here are much less than those of corn ethanol, including: deforestation, a major problem in Brazil already, and the acreage needed for sugar cane is estimated to double in the next decade; the burning of cane fields, releasing methane and nitrous oxide which are greenhouse gases; and the fact that the cultivation of sugar cane requires a warm climate.

Although cellulosic ethanol is still in the research and development stage, it holds amazing potential because it would be created from agricultural, forestry, and municipal wastes such as leaves, sawdust, paper waste, and grasses rather than from food sources. Obviously cellulosic ethanol would be renewable, and could possibly emit 91% less greenhouse gas than gasoline and replace 13% of global oil consumption. This is all speculative though, as a means to cheaply and efficiently break down cellulose is required before any manufacturing is possible.

Another category of biofuels is biodiesel, made from chemically altered plant oils. Canola oil is currently used in Germany to make biodiesel; whereas the US is using soybeans. It is also produced from corn, olives, safflower, and peanuts. Some of the positives behind biodiesel are that it is renewable, biodegradable, has greater lubricity than other fuels, and that its energy balance is much better than ethanol. Also, combining biodiesel with other fuels, namely diesel, can increase the overall efficiency of the fuel. This is already occurring at the pump, even in the U.S. In its production and use currently, biodiesel emits 68% less greenhouse gases than diesel from fossil fuels. The main drawbacks for biodiesel are the low yield and high costs in its production. It is also very expensive to switch vehicles from gasoline to biodiesel and soybeans are almost as bad as corn environmentally in terms of erosion.

Still in development is a promising biofuel that could come from algae. The benefits are that algae is fast growing and can be grown essentially anywhere, even in wastewater and seawater--all it needs is sunlight and $CO_2$. Both U of A and ASU are doing algae research. Currently the AZ Public Services' Redhawk Power Plant is testing high density system of fast-growing green scum fed by power plant exhaust. Estimates are that algae could potentially yield 5000 gallons of biodiesel an acre a year. Of course there are negatives: the costs for production and harvesting methods as seen in the Redhawk Power Plant are astronomical compared to the yield so far and producing the fuels on a large scale could take many years due to the lack of biomass at the moment.

The article claims that the future in growing fuel will be based on supply, efficiency, and price at the pump. For biofuel breakthroughs to occur and be implemented nationally and globally, however, a number of natural and social scientific disciplines must be involved. The two major natural sciences involved are biology, for choosing and cultivating the plants, and chemistry in creating the fuels from the plants. Natural sciences also include the physics/engineering behind the production processes, along with ecology, climatology, and agriculture, all facets of biology with the plants. On the social sciences side, political science, psychology, economics, and conservation education come into play. Consumers must understand the advances that occur in the realm of biofuels and be motivated to choose biofuels over fossil fuels, even if they are competitively priced. The scientific research that makes biofuels workable and affordable must be complimented with understanding of what motivates people to act responsibly for the planet.