The Current Role of Biofuels in the Modern Fuel Market and the Future Development of Advanced Biofuels

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Introduction

Biofuels are renewable plant-based energy sources, and there are two types currently in the fuel market: bioethanol and biodiesel. Presently, the global supply of biofuels is produced from edible feedstocks such as sugarcane, soybeans, and corn. This creates an issue concerning sustainability because an expansion of biofuel usage may pose a threat to food supplies. As energy experts look into a larger transition to the utilization of renewable energy, nontraditional sources for biofuels such as switchgrass and algae have been considered.

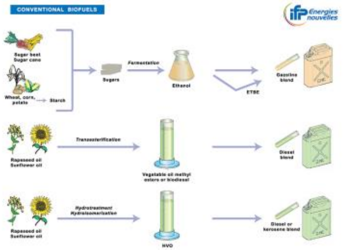

Figure 1. *The image depicts the conversion process to make conventional biofuels fuels from oil-containing plants that are also food sources, such as sunflower oil, wheat, corn, and potato.*

The Second-Generation

The second generation of biofuels describes a class of fuels sourced from renewable plant-matter that is not edible feedstock.
The criteria for a viable potential source of second-generation biofuels are that it is sustainable and can be consumed on commercial scales without environmental degradation, and that the source does not directly compete with food production.
Lignocellulosic ethanol is a bioethanol fuel that is produced by converting cellulose in plant-matter, such as switchgrass, into ethanol. BTL diesel is another variety of second-generation biofuels. Algae has shown potential as a possible third-generation of biofuel.

Evaluating Switchgrass and Algae

Switchgrass as an alternative source of bioethanol has benefits over the traditional corn feedstock, but has similar complications in regards to performance in engines with higher ethanol blends. It has been shown that second-generation biofuels reduce carbon dioxide emissions up to 15% from first-generation biofuels. The main concern is the amount of land that would be required to produce a consistent feedstock supply of plant matter to sustain commercial-level consumption, which can amount up to 357,000 acres depending on the variety of grass.

Figure 2. *The map to the left shows the regions of North America where switchgrass has adapted to grow, demonstrating its ability to grow in various climates and conditions.*

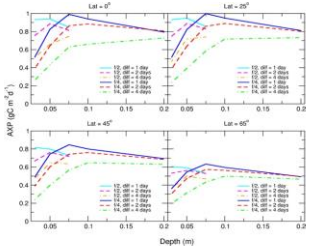

Figure 3. *The set of graphs to the right show the optimized aerial biofuel production (AXP) from microalgae at four different latitudes and a range of depths, with varying nutrition and harvest frequency.*

Algae is beneficial because it can grow in many conditions, but it would require a volume of resources (such as water) that producers are not equipped to accommodate at the time. The optimal region for algae growth is at the 15th parallel north, based on most consistent sunlight availability year-round, which also raises concerns of what country would be able to facilitate large-scale harvest operations because photobioreactors are still in development for use at this scale.

Conclusion

A transition to biofuels (regardless of the source being edible feedstock or not) will require vehicles to run on higher ethanol biofuel blends. It will also require the restructuring of refineries to process volumes of biomass suitable for commercialization. Agriculturalists will need to plan the necessary allotment of land and resources to support biomass cultivation. The switch from petroleum products to renewable biofuels is critical to sustainable energy consumption, but the industry must restructure itself to accommodate the required changes.

Figure 4. *The image to the right is of Algae System's half-acre algae photobioreactor located in Daphne, Alabama, where algae is harvested in floating mobile pods for biofuel production, and is connected to the city's wastewater treatment system.*

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