DEEP FRIED TO FREE RIDE:

Feasibility Analysis of Converting Vegetable Oil to Biodiesel

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INTRODUCTION

Recently a pseudo-market has developed for waste vegetable oil (WVO) as people are finding quick and easy ways to convert it to usable biodiesel. The properties of WVO require only simple conversions to make it usable to most any vehicles that run on diesel engines. Such a characteristic has facilitated a rising demand for waste oils which has produced a complex market with several players representing various scales and volatile prices. Most of the process today are carried out as small scale ventures, by individuals or small businesses, largely because the amount of WVO available to these consumers comes locally. Is there enough WVO to create an economically viable collection and refining system on a larger scale? It is likely that the supply of WVO is not enough to make a viable market on a large scale (i.e. state or nationwide). However, smaller scale markets (such as powering a fleet of city vehicles or a campus transit bus) are appropriate as the young market continues to develop. More research should be conducted at the College of Saint Benedict and Saint John's University to further investigate the possibility of running a LINK bus off of their own WVO from campus dining establishments.

METHODS

The feasibility of applying WVO to varying scales required the analysis of the market today including:

- A review of the barriers to application of WVO vs. normal petrol-based diesel
- An analysis of the current sources for WVO entailing current supply levels and the associated supply levels*
- An investigation of the market players from large industrial collectors and refiners to smaller businesses and individuals
- A collection of case studies from 2 campuses:
  1-St. Cloud St. University's Husky Fried Ride Program (metro transit bus that runs off WVO)
  2-Loyola University Chicago's Center for Urban Environmental Research & Policy (CUERP) Biodiesel Program (student run program that facilitates the collection of campus waste oils as well as WVO from the surrounding community)

This research lays ground work for developing a possible system on the CSBSJU campus.

*The supply of WVO nationally was extracted from the US Census Bureau Fats and Oils Consumption Page. The data the bureau keeps is labeled as "yellow grease" which is a conglomeration of restaurant grease and animal fats. Only a percentage of that total is available for biodiesel production because it also is used in the production of animal feed and several other industrial applications.

RESEARCH

Barriers for Use

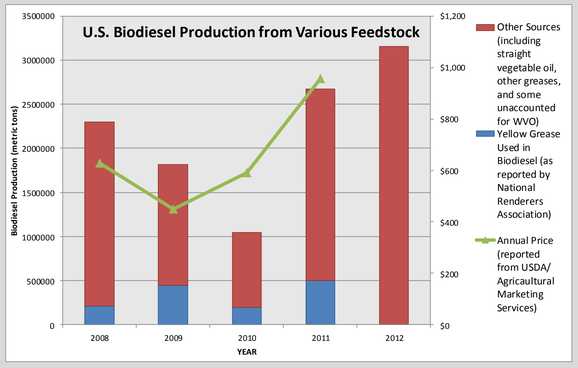
Chemical Properties: Vegetable oil is fundamentally different from petroleum so it requires refining or an engine modification.

Poor Quality Concerns: WVO has variable quality, meaning the cost and efficiency of conversion to biodiesel batch to batch can vary.

Highly Viscous Higher viscosity than petroleum based fuels can bog down engines. This also creates problems in *colder weather environments* because lower temperatures increase viscosity of liquids. There are engine modifications and fuel additives available that prevent this from being an issue

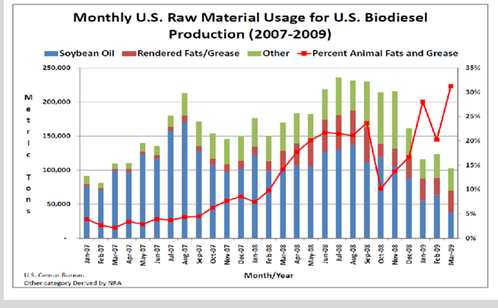
Limited Supply: Supply of vegetable oil has an effect on the price for obtaining WVO. As the demand increases, the limited supply the price for WVO will rise. Being that utilizing waste oil is most profitable because it is generally a cheap supply source, a rise in competition may make the application of WVO tougher.

Table 1. Restrictions for using WVO on a larger scale



LEFT Table 2. U.S. Biodiesel Production from Various Feedstock. Bars represent two basic feedstock: Yellow Grease (blue) and Other Sources (red). Yellow grease is used for several other applications besides biodiesel but the amount used for biodiesel is rising. However, as this percentage rises the price (green) has also been rising.

RIGHT Table 3. U.S. Biodiesel Production from 2007-2009 and the corresponding percentage of animal fats and grease used in biodiesel production. Biodiesel production dipped after 2008 due to economic hardship but have since recovered. This table represents the flexibility in biodiesel production over shorter time periods.



DISCUSSION

Dining Establishment	Quantity of WVO Recycled Each Year	Biodiesel that Can Be Produced
SJU Dining	5250lb 655 gallons	5170lb 645 gallons
CSB Dining	7000lb 847 gallons	6895lb 835 gallons
TOTAL	12,250lb 1502 gallons	7465lb 1480 gallons

Table 4. Quantity of recycled WVO that is obtained from the various CSBSJU dining facilities and the corresponding biodiesel that can be produced from that WVO. Biodiesel production efficiency is assumed to be 98.5%, meaning that the amount of biodiesel that 1 gallon of WVO equals approximately .985 gallons of biodiesel after refining. Efficiency number is based on Loyola Chicago's biodiesel program. CSBSJU Transportation uses approximately 27,500 gallons of diesel fuel per year. Based on this data, WVO could account for a little over 5% of overall fuel costs.

http://www.tootoo.com/s-ps/ld-c-used-vegetable-oil-purifier-

Left: Sample refining machine that filters and purifies WVO so that it is a usable fuel. Costs of such a small system run as low as $1000

CONCLUSION

WVO is proven as a reliable and usable fuel source that is easily accessible for most anyone interested in capitalizing on its low economic cost. However, the market for the oil is already saturated with the demand from several private interests. Yellow grease represents the remaining available biodiesel feedstock on a large scale basis, but the consumption of the material is devoted to other uses. Thus, there simply isn't enough untapped WVO that could serve as a significant substitute for petroleum based fuel at a large scale. Still, WVO represents a fuel that is reliable at smaller scale levels as is being done at other locations such as the St. Cloud State Husky Fried Ride or the Loyola Chicago Biodiesel Program. CSBSJU should further consider the possibility of switching a bus of their "Link" system to running off biodiesel that utilizes WVO from on campus dining facilities. If capital investment isn't too high, then running one bus should be feasible.