



**CALIFORNIA STATE SCIENCE FAIR  
2009 PROJECT SUMMARY**

<b>Name(s)</b> <b>Erica Fine; Sonya Sidhu; Gunnar Thordarson</b>	<b>Project Number</b> <b>S0811</b>
<b>Project Title</b> <b>The Potential for Vegetable Oil Based Fuels as a Substitute for Diesel</b>	
<p style="text-align: center;"><b>Abstract</b></p> <p><b>Objectives/Goals</b></p> <ol style="list-style-type: none"><li>1. Compare the trade-off in performance between petroleum based Diesel and Vegetable Oil based fuels in Diesel Engines in terms of Emissions(CO<sub>2</sub>; CO;NO<sub>x</sub>; Hydrocarbons),Carbon Footprint,Miles per gallon and Economics.</li><li>2. Test the performance of different Fuels in our converted Mercedes Research Vehicle:Vegetable Oil(Soy,Canola,Peanut,Corn);Waste Vegetable Oil(Soy);Bio-Diesel;and Diesel.</li><li>3. Evaluate the potential for Vegetable Oil based fuels to play a greater role in our Energy Economy.</li></ol> <p><b>Methods/Materials</b></p> <p>We converted a 1987 Mercedes diesel to run on a variety of fuels. A special test tank,fuel pump and heat exchangers were installed. Each fuel was tested on an 11.4 mile test course and the MPG determined. Each fuel was also tested for emissions using calibrated smog equipment.</p> <p><b>Results</b></p> <p>In terms of emissions,vegetable-oil based fuels were clearly superior over diesel in its impact on greenhouse gases(CO<sub>2</sub>),but did show higher levels of nitrous oxides(NO<sub>x</sub>)and hydrocarbons.In terms of performance,Diesel has the highest BTU/gal and we expected to see a 13% drop in MPG for vegetable oil. We measured a reduction of only 5.6% which may be due to more efficient combustion. When we compared a number of vegetable oils, we found the best performance with Waste Soybean Oil and Canola Oil. We believe the higher performance is due to the lower levels of saturated fats. The economics of fuels was determined on a cost per mile.Waste Vegetable oil was the cheapest at \$0.03 per mile. Pure vegetable oil based fuels were about 40% more than diesel. This gap could be reduced if vegetable oil was produced at greater scale. Waste vegetable oil will only ever provide about 0.5 B gallons of fuel compared to a need for 63 B. We considered how high-oil yielding plants such as castor beans, jatropha, coconut and palm oil could be leveraged to displace a greater quantity of diesel. The highest oil producing plant on a gal/acre/yr basis is algae which could be scaled to displace petroleum based diesel.</p> <p><b>Conclusions/Discussion</b></p> <p>If we were to take 10% of the 243 m gas vehicles off the road and substitute high MPG diesel cars (+75 mpg), we would displace +10 B gallons of fuel, more than any other energy conservation effort. With a greater number of cars burning diesel, algae oil and plant based oils could be scaled. Substitution of these fuels will benefit the environment, reduce our dependence on imported oil and potentially reduce energy costs.</p>	
<b>Summary Statement</b>	
<p>Our project considers the trade-offs in performance, emissions and economics of vegetable oil based fuels as compared to petroleum based diesel and looks at how we can reduce greenhouse gases and our dependence on imported oil.</p>	
<b>Help Received</b>	
<p>This project was conducted by our team. Mr Laity (parent mentor) and Mr. Robertson (chemistry teacher) each helped critique our work and challenge us with questions and issues. This project was completed as a team as the research vehicle had to be driven by one of us as others noted data, road conditions and time.</p>	