



**CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY**

Name(s) Sierra G. Freitas	Project Number 34610
Project Title Looking for the Best Blend of Biofuels	
Objectives/Goals My project "Looking for the Best Blend of Biofuels" is about testing and finding the best biofuel blend based on cost and performance while using alternative energy to produce biofuels. My hypothesis was that 50% cooking oil/50% petroleum diesel would be the best blend based on cost and performance. Abstract Methods/Materials I designed and built a solar and wind powered biofuels refinery in my yard in which I processed over 200 gallons of waste vegetable oil I collected from three restaurants in my city. I converted the used oil into clean, dewatered and filtered cooking oil using my home built solar heat exchanger, photovoltaic & wind powered pump through my three tanks, 20 micron and 1 micron filters. I blended cooking oil with defined amounts of petroleum diesel. I also converted separately, cooking oil into biodiesel and blended it with the same percentages of petroleum diesel. I tested the different blends in a diesel car and in my diesel generator connected to a 3000 watt load. Biodiesel is very similar to cooking oil except it is processed with chemicals. I used many titration tests to see how much potassium hydroxide (catalyst) was needed in each batch to separate the glycerides from the oil. I used methanol to bond the glycerides and separate these free fatty acids from the oil. I tested the biodiesel for complete reaction with water tests. I poured hot water into the biodiesel and after an hour there was separation between the water and oil as long as there were no emulsions (compounds that allow water and oil to bond). I continued to do this three times until the separated water looked clear. I then dehumidified the biodiesel, blended it with petroleum diesel, and ran it in a car and in my diesel generator. I ran multiple sets of tests with all 6 blends. On the diesel generator, I measured the voltage, amperage and time with all 6 blends to determine the watt hours which I equated to power density for my analysis. I also tested in a 2006 VW Jetta TDI with all 6 blends and measured mileage. Results The 50% cooking oil and the 50% petroleum diesel was the best blend based on cost and performance. Conclusions/Discussion My hypothesis was proven correct, the 50% petroleum diesel/50% cooking oil was the best blend. The 70% petroleum diesel/30% cooking oil blend had 4.1% more energy, however, the 50% petroleum diesel/50% cooking oil was 20% less expensive, therefore making it the best blend overall.	
Summary Statement Find the best biofuel blend based on cost and performance using alternative energy to produce it.	
Help Received Teacher helped with electrical system, uncle helped with chemistry, dad helped with construction, acquaintances helped with explaining the process, classmate's dad provided test car	