Fleet Optimization

After researching alternative fuels and electric cars, our team decided that implementing more fuel efficient cars into the Penn State fleet would be the best choice on our way to sustainability. Our research proved that the Ford Fiesta is the most logical choice for a fuel efficient cars because we will save more on gas without sacrificing horse power and cargo space.
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Introduction

The objective of the Siemens Sustainable Campus project was to research elements of the “Sustainable Cities” concept and apply those elements to make Penn State’s campus more sustainable. When given this task, our team decided to address transportation on campus and after more research, we wanted to focus in on the fleet of cars. The Fleet Operations provides a full range of vehicle services to the University community, including daily and long-term vehicle rental, chauffeur and driver services with a bus or trolley.

Sustainability is based on the idea that everything we need for our survival and well-being depends on our natural environment. In order to preserve this environment we must work with nature by cutting down our ecological footprint by living a sustainable lifestyle. We used this idea of sustainability when focusing on the Penn State Fleet of cars.

Our first idea was to implement fully electric cars into the fleet, minimizing the need for fuel and cutting out the cost for gas. However, we soon realized this would not be feasible. Most electric cars cannot hold enough charge to travel very far and they are not fast enough to travel at highway speeds, which was an issue because the Penn State Fleet of cars travel all over the country. The electric cars that we did find capable of reaching 60-70 mph were way too expensive. Our next idea was to consider finding a more “green fuel,” such as biofuel. Biofuel is fuel directly derived from living matter, such as corn and other plants. By using biofuel in the fleet, specifically cellulosic ethanol, we would cut down on our carbon dioxide emission by eighty six percent. One issue with this plan was we would have to convert all the engines so they would be able
to run on this alternative fuel. In addition to changing the cars’ engines, another problem was the lack of availability of cellulosic ethanol. Biofuels are still being researched and have not been mass produced at an affordable cost. Also there are no gas stations in the United States that offer biofuels. In the future this will be a good idea, but it is not developed enough to use in the fleet of cars today. This leads to our final idea. Our final design is not a way to transfer the fleet to a more sustainable fuel source; however, it is a substitution of the cars currently in use. In order to minimize the carbon footprint of the fleet, we would substitute cars in use with ones that are more fuel-efficient. This was our best option because these cars are already readily available and proven to reduce your carbon footprint.

**Concept Development:**

For our criteria we choose 6 things that were important to our project.

The Criteria were

- Cut down greenhouse emissions by 50 percent
- By 2016, have 50% of the fleet running on sustainable energy.
- The New design is possible with technology available.
- Reduce spending on fuel by 25 percent.
- Reduce fuel consumption of the fleet by 50%
• Savings in the long run outweigh the cost in the short run.

Through our concept development we evaluated these criteria to find out what was most relevant to our project. Through the matrix we determined that the new design being possible with technology available was the most important. This makes sense because we want our project to be able to be implemented so that this can help make the university more sustainable. It does not make sense to design a project that is not possible to implement. The next most important criteria was that we cut down carbon emissions. This is important because we want to reduce our carbon footprint and have as minimal an impact on the environment as possible. Reducing the fleet’s carbon emissions could have a very positive impact on the environment. The other important criteria was to reduce the fuel consumption of the fleet to save money for the university. This is what allows the project to be an option because there has to be some money incentive for the university to implement this project.
Cutting down the fuel consumed will not only save money but reduce our dependence on fossil fuels.

We identified possible solutions that could help to make Penn State’s fleet of cars to be more sustainable. The five ideas that we came up with were to keep the cars in place, or switch them out with one of the following: Electric Cars, Biofuel Cars, Hybrids, or more fuel efficient cars. These were selected because they seem like possible solutions that needed to be considered when looking to optimize the fleet of cars.

Concept Selection:

We evaluated the concepts that we had selected against the criteria that were most important. Using a concept scoring matrix we evaluated the concepts against weighted criteria to give each a final score.

Standard cars were looked at but this basically means leaving the fleet as is and not swapping out any cars. This doesn't make sense because many of the current cars are not fuel efficient and could be improved. Most of the cars average around 22 to 23 miles per gallon, which is pretty average but could be improved. By not switching the cars we are not doing anything to solve the problem.
Electric cars were the next thing that we wanted to investigate. This would obviously be a great option because electric cars do not run on fossil fuels and would save lots of money on fuel costs. But there were several problems with electric cars that make them difficult to implement. First off, all the cars in fleet are travelling long distances up and down the east coast and most electric car can travel long distances. Cars like a Nissan LEAF only go around 75 miles on a full charge. They are also expensive. To get an electric car that can go over 100 miles it is at least 60,000 dollars. Then you also run into the problem of how will people charge them on their road trips. Electric cars would be a good solution but are not a viable option at this time.

Biofuel cars were the next option we discussed. It is not too much more expensive to get a biofuel car than a standard car. Biofuel cars are much more efficient and do not run on fossil fuels. This would make the Penn State fleet much more sustainable. This was the best concept determined by our scoring matrix. There are some problems with biofuel right now though. Biofuel is not that readily available. Penn State would not have a problem with getting fuel for the cars but the problem would be finding fueling station on the road. Gas stations do not carry biofuel so the person driving the car would not be able to refuel. This makes biofuel not an option right now, but it is a definite possibility in the coming years.

The next options we took into consideration were hybrids and more fuel efficient cars available right now. Hybrids right now are becoming much more popular and can
save the fleet a great deal on fuel consumption. Hybrids right now usually get around 40 miles to 45 per gallon on the highway, which is a big improvement over the current vehicles. Hybrids are more expensive than normal cars though. A standard Toyota Prius costs around 25,000 dollars which is a high price when you have a large fleet. That is why we believe it may be a better option to just go with more fuel efficient cars. Many available compact cars can get 35 miles per gallon on the highway. This is slightly less than hybrids, but that is made up in cost. A standard ford fiesta usually ranges from 13 to 17 thousand dollars. That is almost 40 percent cheaper, and also maintenance is less on standard cars than hybrids. More fuel efficient cars finished second in our concept scoring, but we believe it is the most plausible option at this moment.

Cost and Implementation

With a price range of thirteen thousand to seventeen thousand, the Ford Fiesta is certainly the most cost effective—as well as the most fuel-efficient and the most eco-friendly—replacement for the currently used mid sized cars in the fleet. With an average annual savings of over five hundred dollars over the Impala and the Avenger, the Fiesta would be the ideal substitute for the PSU fleet management to make. If the Fleet would be willing to sacrifice five hundred thousand dollars of its annual two million dollars,
roughly thirty-three 2012 Fiestas could be purchased annually. If the fleet were to then sell thirty-three of their replaced cars (whether it be the Impala, the Avenger, or the Ford Fusion) at a low price of eight thousand dollars they could make back roughly half of what was spent on the Fiestas. Now with this money, the Fleet management could either purchase more Fiestas or save the money for gasoline costs and/or maintenance. With the savings on gasoline per year, the fleet would save an additional sixteen thousand dollars annually on gas. It is also important to mention that all of the gasoline numbers and car prices come from a governmental website and are up to date and accurate; all based off 2012 car models. If the Fleet were to begin implementing our suggested plan, within five years they could have nearly forty percent of the fleet made up of the more fuel efficient and eco-friendly Fiesta. With this in mind, the overall fleet savings on gas annually would amount to eighty-two dollars. In terms of carbon emissions, this would amount to sixty six million grams less tailpipe carbon dioxide emissions per year (based off of a four thousand annual mile estimate given by a Fleet worker). Even though the Fiesta runs on non-ethanol gasoline, the annual savings on gasoline and reduction in carbon emissions make the Fiesta an ideal substitute for the Fleet. Switching to the Fiesta would make for a greener and more sustainable Penn State. Sacrifice some money now for the pay off later.

**Conclusion:**

The objective of our project was to attempt to reduce the ecological footprint and improve the sustainability of the Pennsylvania State University fleet of cars. We researched many approaches to this problem, but decided that with the technology currently available and the funds that are possessed by the Office of Physical Plant,
simply exchanging the current cars possessed by the fleet with more modern, fuel-efficient cars would be the best option. Nevertheless, even this option was met with some difficulty. With a budget of $1.9 million, the OPP would be hard pressed to replace their hundreds of cars with more fuel efficient ones. The ideal situation would be to put about $500,000 dollars towards 30-33 new cars purchases to replace the older ones. However, it is unknown how the funds are distributed amongst the OPP and therefore we do not know how much could be spared for the new cars.

With an eye towards the future, our group also researched other options to revolutionize the fleet. One option was electric cars. However, this concept was shot down within minutes of researching because of two main problems – one, the cars simply do not have the infrastructure to support the long distances required by the university. Recharging stations are rare at best, and this would make refueling the cars nearly impossible. Also, the electric cars that could travel at highway speeds were exceedingly expensive and would not be viable for the OPP to purchase. Another idea that we hypothesized was the introduction of new forms of ethanol to fuel the cars. One in particular that we researched was cellulosic ethanol, which is extracted from the non-digestible parts of plants. It resulted in an 86% reduction in greenhouse gas emissions, but the production of cellulosic ethanol is so new and small-scale that currently it is simply not feasible for the fleet to use.

Overall, with the current technology and funds available to the fleet, we decided the best course of action would be to replace older fleet cars with new, more fuel-efficient models. The transition will take several years, but the reduction in fuel costs and ecological consequences is well worth the capital needed to fund the project. As
technology progresses, other options will become more viable, but for now fuel-efficient hybrid vehicles are the best option for the fleet.

References


