The Environmentally Friendly Solar & Wind Powered Vehicle

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Summary

For centuries, humans have been burning fossil fuels to create energy for combustion vehicles. However, fossil fuels hurt humans and the environment we live in because of the large amounts of Carbon dioxide that is let out into the air (Gurney, et al, 2019). These gases trap heat and cause global warming. For that reason, different ways to avoid using fossil fuels are always being explored. Electric cars were invented for this purpose because they require a charged battery to function rather than using fossil fuels. In this paper, we propose a new way to use solar and wind energy to make an electric car function which will require less charging time. In order to do this, solar panels and wind turbines will be attached to the car. The solar panels and wind turbines will convert solar energy and wind energy into electricity. This solar/wind/electric hybrid car will be easier than driving an electric car because the owner will not need to charge it as often. Solar and wind technology is already well known, however they have never been used together in a car. This proposed idea should also help future engineers think of ideas to create more environmentally friendly cars. This may also inspire more ways to use renewable energy in different places such as in our houses. It may also aid with the discovery of the process of different types of renewable energy. Different types of equipment will be needed to make our solar/wind/electric hybrid car possible. We will need solar panels, mini wind turbines, and connection wires which will cost a total of $14,890.00. We will also need to hire a mechanical, electric, chemical, and industrial engineer to properly design those parts and place them in the electric car system which will cost $231,000 to $391,000 annually.

Author Note

This paper was prepared for English 21007 taught by Professor Susan Delamare.

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Introduction

There is a growing need for renewable and clean energy as air pollution threatens the livelihood of many people today. Half of the population in America live in an area with poor air quality that doesn't meet federal standards (Vehicles, Air Pollution, and Human Health, 2014). Combustion vehicles such as cars and trucks are the leading cause of this. They contribute to a significant amount of nitrogen oxides, carbon monoxide, and other pollutants that burden the health of the ozone layer, people, and our health care system. (Vehicles, Air Pollution, and Human Health, 2014). We propose a clean and renewable alternative to combustion cars; a solar, electric, wind hybrid vehicle.

Solar and wind technology is already being used to collect clean energy by major corporate bodies (Renewable energy explained, 2019). What we are trying to do is incorporate that technology into an environmentally friendly car. Solar cars work by converting energy of light into electrical energy using photovoltaic cells. The electric energy will go to the storage batteries and the electric motor (Wah, 2012). When there is little sunlight the energy from the storage battery will be used. However, when there is sunlight the extra energy absorbed would be stored in the battery. Silicon is a nonmetal with conductive properties and that is what helps it create the electric current in solar panels (Osmanbasic, 2019).

Engineers should find more ways to utilize energy towards vehicles in clean and renewable ways and try to prove combustion technology as something of the past and make way for future innovation in clean and renewable technology. Using solar powered cars rather than non energy efficient vehicles will reduce air pollution. Air pollution is not only dangerous for the environment but for human health too. It harms the lungs and may cause premature death. The

use of clean energy in cars reduces not only pollution but also noise, since solar, wind and electric powered cars work silently. Gas powered cars produce a lot more noise since it undergoes a chemical reaction however, with our car this will not be the case as electric cars produce significantly less sound.

A solar/wind hybrid powered electric car would be very important for the solar industry as a whole. It would eliminate the need for combustion engines as people will choose clean renewable energy over chemicals that could harm the environment and their neighborhoods. It would also be better than purely electric cars because the need for electric power stations wouldn't be significantly reduced. Energy would come straight from sunlight or wind to power vehicles using this technology. The solar industry would drastically improve as there would be a need for solar/wind hybrid vehicles for consumers and therefore more improvements in that kind of technology would branch out towards other industries. Research in newer and better technology in all three of the major clean energy industries, solar, wind and electric, would be more common. Research in not only new technology but how we use and improve that technology for future generations of engineers would be just as common. Fossil fuels are usually found in certain habitats and are destroyed by people trying to claim it. Solar energy would reduce the need for fossil fuels for cars and therefore protect much of the wildlife and habitats. Fossil fuels will eventually run out so the need for this type of renewable technology is evident. This allows these industries to have a good public image. Knowing that the solar energy industry is on a mission to replace these fossil fuels would allow the governments of the world and their respective population to understand its importance and give the support these industries need from the public with the necessary funds as well.

Objective

Our objective is to first research our proposed idea of a solar, electric, wind hybrid car and its ability to reduce the air pollution we are all experiencing today. We first need to research the current technology available in solar and wind energy so we are able to combine it with an electric car. We can then use existing models of various project cars to determine how our hybrid car could look once we know how the technology will be able to work with one another.

Once our research is completed we will then move into engineering and designing the car within a one year timeline as shown in (Appendix). Our first couple of months will be dedicated to experimental design and analysis as well as gathering the necessary equipment. The following months would be dedicated for modeling, prototyping, and finally manufacturing the car. Our closing months would be for final testing as well as our annual review to see the precise costs we had to undergo. All deadlines would be enforced by project leaders such as the lead design engineers to meet the due dates of each step we have to go through. It is important that in order to meet the one year deadline that good leaders are placed to keep their engineers on track.

Preliminary Literature Review

Various prototypes of wind powered cars already exist. Many of which are designed with the model of sail boats or with the use of many small propellers, as shown by Richards Burdetts design capture of cars such as the Ventamobile (Burdett, 2016). The article stated that wind powered vehicles worked so well that they needed to be seriously considered as viable alternatives for transportation. Another example of a very efficient wind-powered car would be one that was able to complete a 3,100 mile test run across Australia (Gotto, 2011). Both of these show that the possibility of using wind-powered cars is not some pipedream and will turn into

reality. However, most of the cars listed here still are unrefined in their way of providing electricity. Most vehicles that implement wind or solar energy technology are hybrids. Therefore, the car owner will still need to pump the car with fuel or charge it with electricity. Our model combines solar and wind energy so the car can reach high speeds such as a regular vehicle. The owner will only need to charge the vehicle when there is not enough sun or wind outside. However, solar and wind power would save the owner time since they don't constantly need to charge it. This is why our research would be valuable to be able to streamline the process of providing energy to such a vehicle.

There has been other research as well on solar panels on electric cars. Engineers have tried researching different methods of solar panel placement on cars. There could be an optimal position and angle to place these solar panels so they can perform in the most effective and efficient way possible. Their research concluded that the angle at which to place solar panels on cars does matter and needs to be researched and analyzed more (Ota et.al, 2019). What we could do during the earlier development of our hybrid electric car is test how angle and position, related to the sun, could affect how effective our vehicle could collect solar energy. We could then install technology related to those findings during the prototyping phase of our project car. What these researchers show us is that there is much needed testing and analyzing in the solar industry in regards to how solar panels work in order to transfer it into mechanical movement.

Technical Description

The vehicle we propose is based on existing vehicles that are fully powered by electricity. Currently, electricity has to be inserted into vehicles through a charging port in order to give it the power for it to function (Figure 1). It may take hours to fill up the battery for this type of

vehicle. However, we incorporated solar and wind energy into electric vehicles so it can last much longer without being charged. The only reason the vehicle would need to be charged is if there is an inadequate amount of sunlight of wind.Our vehicle uses all of the components of a fully electric car, but instead of charging it, the sun and wind automatically provide the electricity necessary to power the vehicle.

Figure 1: Electric Cars and Hybrid Cars: Pros & Cons. Retrieved from https://www.travelers.com/resources/auto/buying-selling/electric-cars-and-hybrid-cars-pros-and-cons. (2020)

Our proposal consists of 10 main components which are the solar panels/photovoltaic cells, small wind turbines, an auxiliary battery, onboard charger, traction battery pack, DC/DC convertor, traction motor, transmission, thermal system and power electronics controller (figure 2). The energy from the sun is absorbed and converted into AC electric current by the solar panels on the roof, doors and hood of the car (figure 2). The solar panels we used have a device installed inside of it called a photovoltaic cell which does the actual conversion of energy into electricity (figure 3). The photovoltaic cells excite the light molecules that were absorbed and the movement results in the release of electrons (Osmanbasic, 2019).When there is any wind, the fans on the grille of the car will begin to turn. This will cause wind energy to be produced and converted to AC electricity in which the shaft will convert kinetic energy to electrical energy (figure 4). The movement of the wings (blades) causes the shaft to spin, which allows the kinetic energy to convert to electrical energy (Good Energy, 2018). Once the solar and wind energy

have been converted to AC electrical energy, the electricity flows throughout the different components of the car which allows it to function.

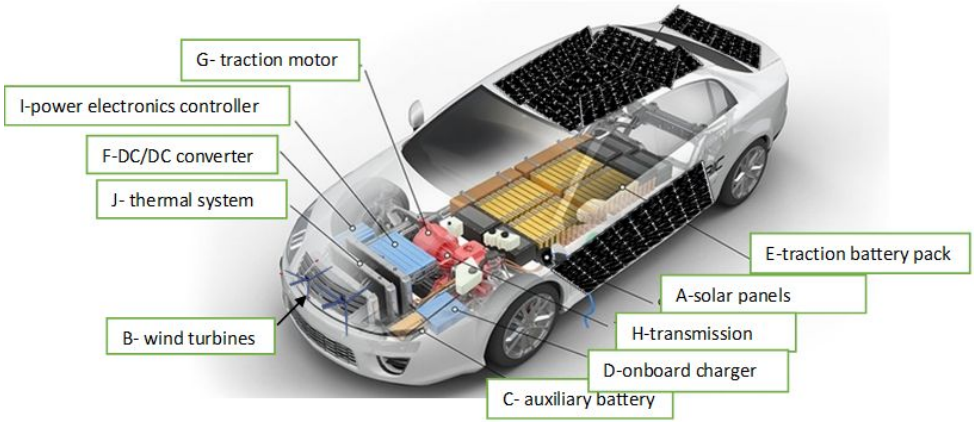

Figure 2: Parts of a Solar/Wind Powered Vehicle. Adapted from https://afdc.energy.gov/vehicles/how-do-all-electric-cars-work. (n.d.)

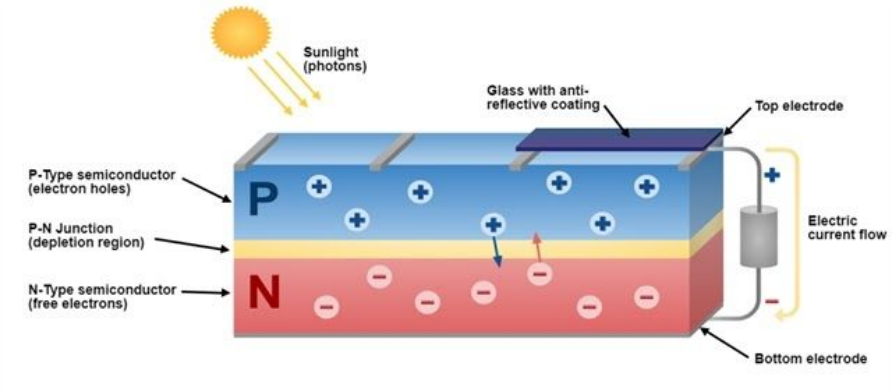

Figure 3: Making Solar Energy Economical. Retrieved from engineering.com/DesignerEdge/DesignerEdgeArticles/ArticleID/19841/Challenges-of-Making-Solar-Energy-Economical.aspx. (2019)

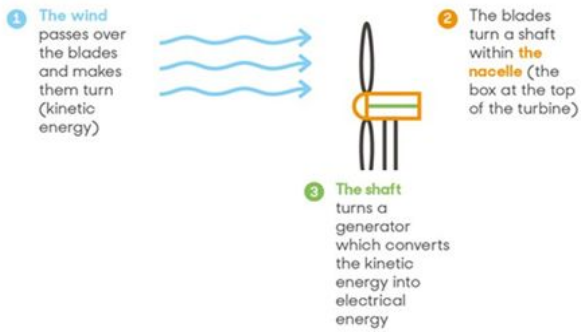

Figure 4: How Wind Turbines Work. Adapted from https://www.goodenergy.co.uk/how-do-wind-turbines-work/. (2018)

Fig. 2A-The solar panels convert the sun's energy into AC current.

Fig. 2B-The wind turbines convert wind energy into AC current.

Fig. 2C-The AC current is sent to the auxiliary battery for storage.

Fig. 2D-The onboard charger converts the AC current into usable DC current since AC electricity cannot be used to power a vehicle.

Fig. 2E-The usable DC electricity is sent to the traction battery pack which stores all of the DC electrical current.

Fig. 2F-The DC/DC converter changes the voltage of the current since each accessory requires a different voltage to function.

Fig. 2G-The traction motor gets the proper voltage of electricity to supply the necessary electricity to turn the wheels of the vehicle.

Fig. 2H-The transmission converts the electrical power from the traction motor into mechanical energy which can be used to turn the wheels of the vehicle.

Fig. 2I- Since the flow of electricity may cause heat, the thermal system is installed to keep the temperature in the appropriate range.

Fig. 2J- The power electronics control makes sure that the electricity is moving properly and the conditions are safe.

Budget Report

Our proposal requires the contribution of four different types of engineers. The mechanical engineer will design the components of the car that allow it to drive such as the motor and engine. The electrical engineer will design the electrical components such as the connections between the solar panels and wind turbines to the battery. The chemical engineer

will be in charge of finding how the components of the car affect the environment. Lastly, the industrial engineer will design the solar panels and wind turbines according to the available space. The equipment that we will be adding to existing electrical vehicles will be 5 solar panels, 3 mini wind turbines and 8 connection wires. The cost of each solar panel and wind turbine was determined by the size it will cover. The support cost is extra money in case more materials or resources are needed. It should only be used in emergency situations when absolutely necessary.

Table 1. *Budget for Solar & Wind Vehicle*

Line Item	Cost	Time	Per Year Total
Personnel			
Mechanical Engineer	$33/hr.	Annually	$55,000-$92,000
Electrical Engineer	$39/hr.	Annually	$61,000-$110,000
Chemical Engineer	$40/hr.	Annually	$60,000-$97,000
Industrial Engineer	$33/hr.	Annually	$55,000-$92,000
Personnel Total			$231,000-$391,000
Equipment			
(5) Solar Panels	$1050.00	One Time	$5,250.00
(3)Mini Wind Turbines	$3,000.00	One Time	$9,000.00
(8) Connection Wires	$80.00	One Time	$640.00
Equipment Total			$14,890.00
Support			$10,000.00
Annual Total			$255,890-$415,890

Note: This table provides all of the costs that are necessary for the research and equipment required to create the best possible solar and wind vehicle.

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Appendix A - Task Schedule

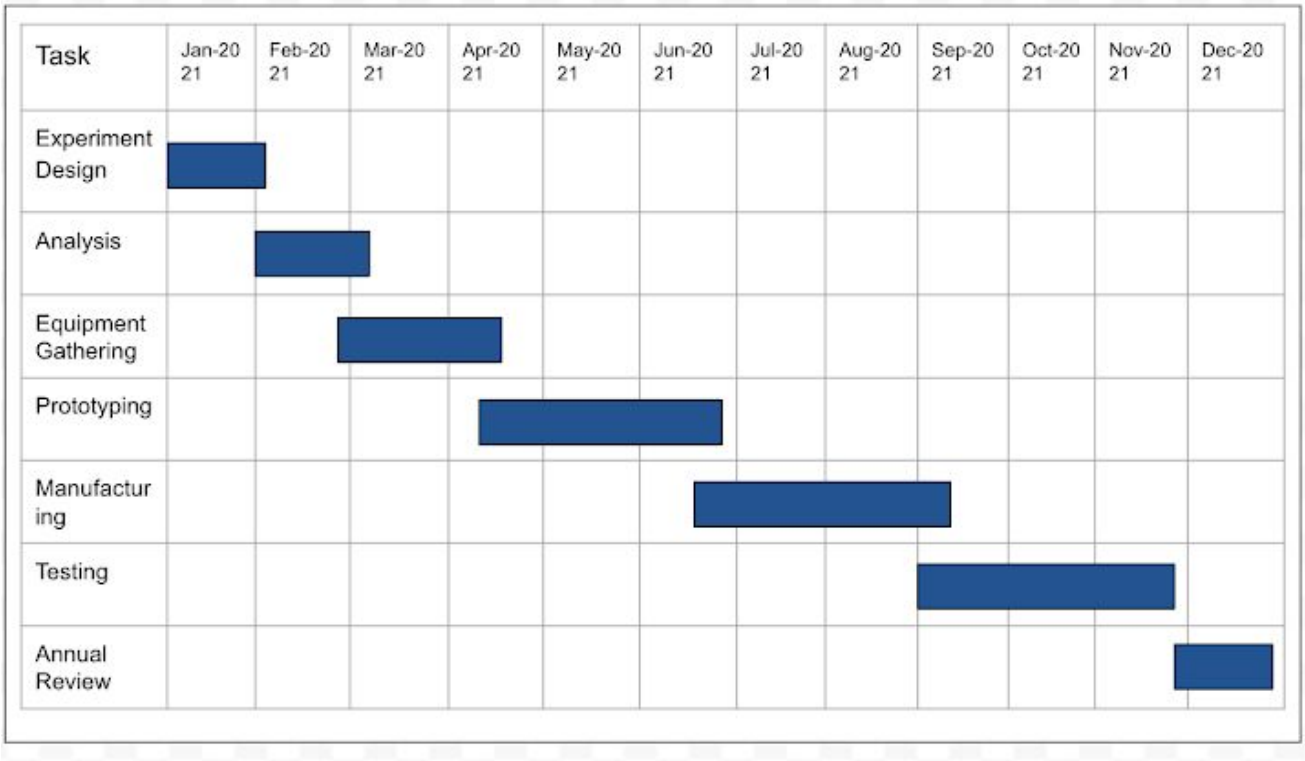

***Figure 5*:** The project task schedule shows the deadlines for the various tasks designed to meet the car's requirements within a year. It will be monitored by team leaders to make sure the project is staying on task and focused.