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"A Description of the Union College 100 MPG Challenge Vehicle"

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Abstract

The personal motor vehicle that replaced horse powered transportation is a marvel that has dramatically transformed society and enhanced the quality of our lives. During the last century increased numbers of people have been able to travel longer distances at higher speeds with increased comfort. Unfortunately, this marvel is not sustainable. Our automobiles are powered by oil derived petroleum that is a finite resource. There is no panacea for the end of the oil age, but public responsibility should call for aggressive conservation and starting to consume oil at a lower rate. This is the motivation for the design and demonstration and ultimate commercialization of a 100 mpg gasoline fueled personal vehicle that is described in this paper.

1. Introduction

There is much public education and concern related to Greenhouse warming of the earth due to burning hydrocarbon fuels. However, the larger looming crisis may be the beginning of the end of the petroleum age. How will the industrialized world that is now depleting this non-renewable oil at a rate 84,000,000 barrels per day adjust to a combination of increasing demand and decreasing supply?

A myriad of alternatives have been suggested for transportation including bio-fuels, French fry grease, wind, solar, hydrogen, fuel cells, tar sands, coal, nuclear and natural gas. While each can contribute, they are relatively feeble, expensive, inconvenient, non-applicable, limited in availability or environmentally damaging.

The reality is that a gallon of gasoline in an internal combustion engine is the best means for personnel transportation that there has ever been and probably the best there ever will be. It is unrealistic to believe increased numbers of people can continue to drive longer distances in larger and faster vehicles.

Thus, a societal goal should be to use the remaining gasoline more efficiently. The "Union College 100 MPG Challenge" is to design and demonstrate a much more efficient vehicle that will necessarily be smaller and slower than existing gasoline fueled vehicle. It may not be as nice as our modern vehicles, but it can be enjoyable to drive. Many

people should find it preferable to continuing the waste associated with oversized vehicles at high speed or the inconvenience of the mass transportation options.

The "Union College 100 MPG Challenge" will carry two persons in tandem and have some storage space. The goal is to travel 40 mpg with six horsepower. We note that prior to the marvelous era of gasoline and the internal combustion engine that is only a century old people traveled at 10 mpg with one horse that required substantial feeding and care.

Our plan is to design, build and demonstrate the "Union College 100 MPG Challenge Vehicle" locally and then across country. It will be presented as an acceptable and realistic option for personal transportation It will define what can and what should be done. It will also be presented as a partial solution to global greenhouse warming.

This "100 MPG Challenge Project" started to take shape during the 2006 spring term as a senior project opportunity for rising seniors. It continued during the summer with the help of a summer research student followed this fall with four senior project students plus another consulting student joining the endeavor. The following sections will describe the successes and challenged we have encountered and the longer range plans to make this vehicle a large scale reality.

2. Summer Preparation

Petroleum from which gasoline is produced represents millions of years of stored energy from the decay of ancient plants and animals. Flukes of nature trapped some in the earth to prevent it from wastefully decaying on the surface. Our earth served as a fuel tank to preserve some of it for modern humans.

The petroleum geologist Dr King Hubbert during the 1950s developed and defined the what is popularly called the Peak Oil model. He showed that the rate of oil discovery at any location follows a bell shaped curve. The rate of production follows the same trend but about fifteen years later.

Peak oil discovery in the United States was in about 1956 followed by peak oil production in 1971. The faculty advisor author of this paper traveled to Titusville, Pennsylvania where the world's first oil well happened in 1859. The one time wilderness of Oil Creek valley between Titusville and Oil City was rapidly lined with oil wells. Methods for drilling, pumping, transporting and refining were rapidly developed in this valley. Peak oil production happened about 1870 and the valley returned to wilderness.

Oil continued to have a limited application of lighting until the gasoline fueled car was introduced in the early 1900s. It then replaced much of coal for heating by 1950. It also became the feed stock for the petro-chemical industry that continues to be the basis for modern plastics, polymers and synthetic rubber and fabrics.

Thus, the challenge is to educate the public to the reality that the world is now using about 84 million barrels of oil per day, and the demand for oil will soon exceed the

production. The public has been taught not to worry because there will be even better alternatives to oil The myriad of suggested alternatives include bio fuels, French fry grease, wind, solar, hydrogen, fuel cells, tar sands, coal, nuclear and natural gas. The public should also be informed that each of these alternatives can contribute, but they are relatively feeble, expensive, inconvenient, non-applicable, limited in availability or environmentally damaging.

These considerations first educate the public for the need and then to demonstrate the need to build and demonstrate a far more fuel efficient gasoline fueled vehicle. It will also have to be smaller and slower than what the public now takes for granted. Summer research student Noel Wallace collected data and prepared a preliminary design. We started with a presentation to the New York State Energy Research and Development Authority followed by a request for some initial funding that has been granted.

An opinion article entitled “Forget Hybrid Cars; Conserve and Think Small” was prepared and published in the Sunday Albany Times Union newspaper on September 3. Positive comments were received by email from readers throughout the United States. The local radio talk show host Dr Joe Perisi invited the author to be a guest for one hour that turned into two hours on Saturday 16 followed by a follow up a week later as a result of much interest that was generated. A professor at a neighboring university who teches an environmental economics course invited the author to talk to her environmental economics class.

Roger Hannay, the president of Hannay Reels, read the newspaper opinion article and sent a check to become the first corporate sponsor of the “Union College 100 MPG Challenge” vehicle.

3. Starting the Senior Project Phase

Students Justin Mole and Matthew Toper had signed up to work on this vehicle for a senior project last spring. Students Mark Angeloni and Michael Guigli subsequently asked to join in the fall. Student Zachary Cramer who is a four year veteran of the Union College Baja vehicle project offered to serve as a consultant.

The Union College engineering machine shop is staffed with three staff members who also have substantial experience with the design and fabrication of vehicles. Roland Pierson is Director of the Engineering Machine Lab. James Howard and Paul Tompkins serve as the Lab Technicians, and have provided valuable suggestions. Additional faculty members have made themselves available with various suggestions.

Along with the broad expertise there has been a range of opinions of how best to build the vehicle. It was agreed to be three wheels because of advantages of licensing it as a motor cycle which may be easier t achieve. There were good arguments and reasons presented over whether the single wheel should be in front or back. A single front wheel with a motorcycle type steering and control has been decided.

The next issue has been the frame design and material. Tandem seating with the engine in back became the plan. Steel and aluminum have been considered for the frame before deciding upon an aluminum alloy. The goal is a vehicle that will require about 6 hp to travel 40 miles per hour. A 12 horsepower engine at no nominally half speed and half power will probably be most efficient. It will also provide reserve for up hill and acceleration.

A single cylinder four cycle engine will be used. A liquid cooled engine of about 200 cc is considered preferable for efficiency and flexibility in mounting. We initially expect to use a stock carburetor and then convert to fuel injection.

The suspension for the front wheel will be the combined telescopic shock absorber used on motorcycles and mountain bicycles. The selection of the rear suspension has proven to be controversial. The faculty advisor had preferred a solid mount in the interest of simplicity, cost and weight and in the belief the tires provide sufficient cushioning for well maintained roads that we hope to operate the vehicle upon. The students, other faculty members and the experts in the engineering machine shop have successfully argued for an independent rear suspension for better handing and comfort.

The students have been working and meeting as a team with individual responsibilities. Michael Guigli has taken the lead with the frame design. Justin Mole will be doing the structural analysis. Mark Angeloni has been considering the engine and transmission options with the assistance of student consultant Zachary Cramer. Matthew Toper is working on the body requirements. Additional assignments will be made for instrumentation and lighting.

Additional funding will be required. Each student has written a proposal for internal funding in support of their portion of the project. Additional funding will be solicited from external sponsors who will be displayed on the final vehicle.

4. Future Pursuits Toward Commercialization

The Union College “100 MPG Challenge Vehicle” continues to be a work in progress that we expect to grow with new participants within the college. We expect to add students with entrepreneurship and industrial economics interests to consider the best paths for large scale commercialization and production.

We have also submitted an abstract of a paper for the ASEE Energy Conversion and Conservation Division for the Annual Conference in June of 2007. An updated and more complete presentation will be made at that time.