Hydrogen Cars

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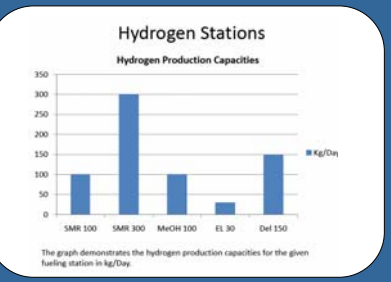
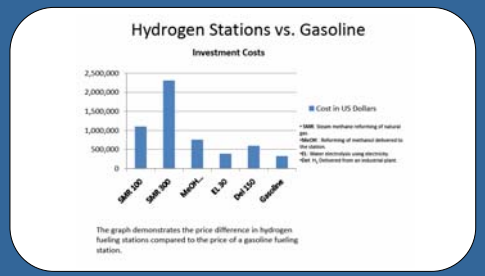
Abstract

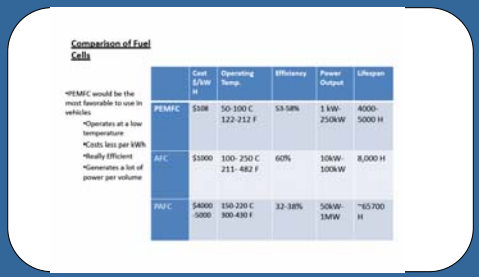
The project resulted in a conclusion on whether hydrogen cars can replace gasoline powered cars. The project investigated the cost, lifespan, and efficiency of fuel cells, the production of the demand of hydrogen for cars, the cost of building a stable infrastructure allowing for convenient refueling, and the current policies, cost, and funding for the technology

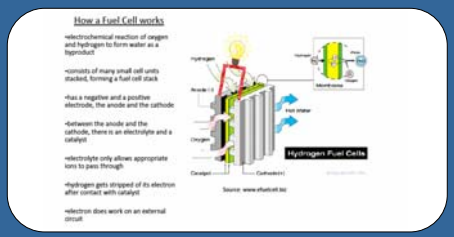
Table of Figures for Various Production Methods

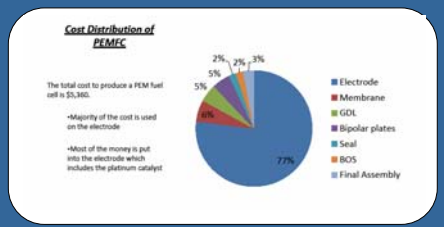
Production Process	Efficiency	Gas Emissions (kg CO_2/kg H_2)	Hydrogen Production ($/GJ)
Steam Methane Reforming	70-80%	7.33	12.75-32.17
Coal Gasification	~50%	29.33	12.75-17.94
Biomass Gasification	50-60%	N/A	17.79
Water Electrolysis	64-70%	0	N/A

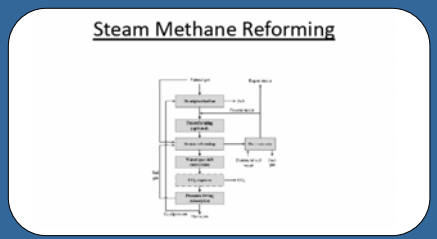












Background

Fuel Cells

Alkaline Fuel Cell

- Uses an electrolyte that is water based solution which consists of potassium hydroxide.
- Operating temperature for the alkaline fuel cell ranges from 90-100 degrees
- 45-60% efficient and it can generate from 10kW – 100kW.
- Carbon dioxide in the system will affect the performance, and the lifespan of the cell.

Phosphoric Acid Fuel Cells

- Uses an electrolyte almost complete out of liquid phosphoric acid (H_3PO_4) in a silicone carbide matrix.
- operating temperature of PAFC ranges from 150-220 degrees Celsius
- Needs a high of the temperature to operate because phosphoric acid has low conductivity at low temperatures.
- efficiency at around 40%, which is lower than most fuel cells

Polymer Exchange Membrane Fuel Cell

- Uses a solid polymer electrolyte
- Solid electrolyte will lead to a longer lifespan and less problems with corrosion.
- Low operating temperature which allows the fuel cell to work a short time after starting the vehicle from 50-100
- 53-58% efficient in cars.
- High power density compared to other fuel cells.

Refueling Station

Hydrogen as an alternative fuel is dependent on an infrastructure that is fueling stations is supplying consumers from two different models: 1) on site production 2) production of hydrogen offsite and transport to station. There are two different types of fueling stations and multiple ways of producing hydrogen there are also multiple ways of transporting it

On Site Hydrogen Production Station

- On site production can be equipped to produce hydrogen from water and electricity, natural gas, and biomass
- Comprised of hydrogen production equipment, purification systems, and compressors along with other mechanical and electrical equipment, safety equipment and storage vessels.

Off Site Hydrogen Production station

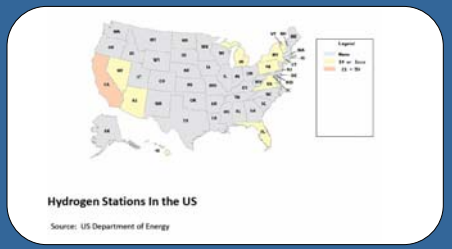
- Has to be effective and efficient ways of transporting it.
- Multiple ways of transporting it.
- three main methods of transporting hydrogen; 1) pipelines, 2)high pressure tube trailers 3) liquefied hydrogen tanker

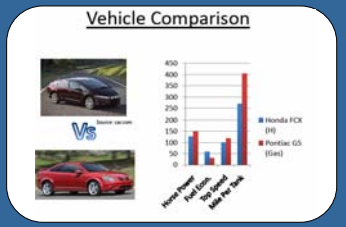
Hydrogen Production

- most efficient way of producing hydrogen is steam reforming
- high pressurized and temperature steam is mixed with methane to produce a product of carbon monoxide and hydrogen gas
- Steam is then added to the product to get further production of hydrogen gas, but instead this time with carbon dioxide.
- Coal gasification in which pre-treated coal reacts with oxygen and steam producing hydrogen.
- Water electrolysis is when electricity is used to separate the oxygen and hydrogen gas. The end product, being hydrogen gas, can be liquefied in all the process, with the exception of water electrolysis which just needs cooling, a special liquefier.

Safety Of Hydrogen Cars

- Hydrogen car is built roughly the same way a petroleum-based car is built
- The cost of the vehicle is higher.
- fuel tank is made of a carbon-based resin (like hardened glue) so that it can withstand contact with outside objects without leaking the contents of the tank.
- construction of the fueling system of the hydrogen car contributes little to the increase in price compared to the fuel tank and fuel cells.





Methodology

Through these are five main objectives of the project:

- Identify the types of fuel cells and their reliability, and conclude the type of fuel cell most suited to be used in cars
- Determine the cost of building a refueling station and supplying it with fuel to sell to the public
- Identify the methods of producing hydrogen and the method which is cheapest, most effective, and most environmentally friendly
- Identify the safety measures of the hydrogen car
- Identify the funding and support for the research and development of the technology

Conclusions

Over the course of our research, we have found that the prospect of the hydrogen car is very much a reality; however, the idea of having a car that produces zero emissions is a very expensive task. To this day there are hydrogen cars roaming the streets of several major cities, but it will be several years before the hydrogen car becomes a "comfortable reality". The cost of fuel cells and the cost of producing/transporting is greater than the cost of producing and maintaining a petroleum-based vehicle at this time; however, because of the research compiled, it is feasible to see hydrogen cars out on the road with the next ten years due to the ever-increasing prices of gasoline and the more cost efficient fuel cell technology that is being produced.