ANALYSIS THE FUTURE APPLICATION OF RENEWABLE ENERGY ON VEHICLE

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This report is submitted as partial fulfillment

of requirements for the award Bachelor of Mechanical

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MEI 2011

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‘I admit that had read this thesis and in my opinion this thesis was satisfied from the aspect of scope and quality for the purpose to be awarded Bachelor of Mechanical Engineering (Automotive)’

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CONFESSION

"I verify that this report is my own work except for the citation and quotation that the source has been clarified for each one of them"

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To my beloved parents,

My siblings

And also

To all my trusted friends

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ABSTRACT

Objective of this project is to study the energy and safety of Fuel Cell Vehicle (FCV) and Electric Vehicle (EV) and to study about Regenerative Braking System and show how Regenerative Braking System Function. A Fuel cell vehicle or FC vehicle (FCV) is a type of hydrogen vehicle which uses a fuel cell to produce its on-board motive power. Fuel cells create electricity to power an electric motor using hydrogen or a reformed hydrocarbon fuel and oxygen from the air. An electric vehicle (EV), also referred to as an electric drive vehicle, uses one or more electric motors for propulsion. Regenerative Braking System is an energy recovery mechanism which slows a vehicle by converting its kinetic energy into another form, which can be either used immediately or stored until needed. By studying the energy and safety of both vehicles, the best car must be chosen based on the comparison of energy and safety. Conclusion of this project is the Electric Vehicle (EV) is better compared to Fuel Cell Vehicle based on energy and safety comparison and how the Regenerative Braking System function is shown from the fabrication of Electric Bicycle with regenerative braking system.

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ABSTRAK

Objektif projek ini adalah mengkaji berkenaan dengan tenaga dan isu keselamatan *Electric Vehicle (EV)* dan *Fuel Cell Vehicle (FCV) dan kajian berkenan dengan system brek regeneratif. Fuel Cell Vehicle (FCV)* ialah salah satu jenis kenderaan yang tidak menggunakan minyak petrol sebagai bahan bakar di samping menggunakan hydrogen sebagai bahan bakar. Kenderaan jenis ini menggunakan *Fuel Cell* bateri yang berfungsi untuk menukarkan hydrogen dalam bentuk tenaga untuk menggerakkan kenderaan tersebut. *Electric Vehicle (EV)* pula ialah kenderaan yang menggunakan satu atau lebih motor elektrik untuk pembakaran dalam kenderaan. Sistem Brek Regeneratif ialah system pemulihan tenaga yang melambatkan kenderaan dengan menukarkan tenaga kinetic ke tenaga lain untuk digunakan terus atau disimpan. Dengan mengkaji berkenaan dengan tenaga dan keselamatan kedua-dua jenis kenderaan tersebut, kenderaan yang terbaik dipilih berdasarkan perbandingan tenaga dan keselamatan. Kesimpulan untuk projek ini adalah *Electric Vehicle (EV)* merupakan kenderaan yang lebih baik dari *Fuel Cell Vehicle (FCV)* dari segi pembandingan tenaga dan keselamatan dan bagaimana system brek regenerative berfungsi ditunjukkan dengan fabrikasi basikal elektrik yang menggunakan system brek regeneratif.

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LIST OF SYMBOL AND ABBREVATION AND NOMENCLATURE

EV	=	Electric Vehicle
FCV	=	Fuel Cell Vehicle
POPA	=	Panel on Public Affairs
CO_2	=	Carbon Dioxide
ICE	=	Internal Combustion Engine
CO	=	Carbon Monoxide
HC	=	Hydro Carbon
NEDC	=	National Engineering Design Challenge
LCA	=	Life Cycle Assessment
PEM	=	Polymer Electrolyte Membrane
CNG	=	Compressed Natural Gas
H_2	=	Hydrogen
NO_2	=	Nitrogen Oxide
LNG	=	Liquefied Natural Gas

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O_2	=	Oxygen
H_2O	=	Hydrogen Oxide (water)
SLI	=	Starting Lighting Ignition

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CHAPTER 1

INTRODUCTION

1.1 FUEL CELL VEHICLE

A Fuel cell vehicle or FC vehicle (FCV) is a type of hydrogen vehicle which uses a fuel cell to produce its on-board motive power. Fuel cells create electricity to power an electric motor using hydrogen or a reformed hydrocarbon fuel and oxygen from the air.

At the beginning of 2002, the World Administration announced the FreedomCAR initiative, an industry-government cooperative effort, to develop fuel cell vehicles. This prompted a subcommittee of the POPA Energy and Environment Committee to commence work on a report about fuel cells and Freedom CAR. The rationale for preparing such a report is that the topic is an important aspect of the nation's energy policy's topic that physicists justifiably feel competent to discuss.

Previous POPA studies have been on nuclear energy, energy supplies, etc. Fuel cells are of interest to the physics and physicists are actively involved in research areas for potential hydrogen storage, such as carbon annotates. The

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materials aspects of fuel cells are especially inside the view of physicists. Overall systems considerations, wells-to-wheels energy efficiency, and related issues can benefit from analysis by physicists. In view of the high expectations for fuel-cell vehicles generated by the Freedom CAR initiative, it seems reasonable to examine what is reality and what is unsupported optimism.

The motivation for the fuel cell vehicle initiative is to reduce dependence on imported petroleum, to reduce emissions of atmospheric pollutants, and to reduce CO_2 emissions by improving fuel economy and/or by going to a hydrogen-based system. Since the transportation sector itself uses more oil than produced domestically. Fuel Cell vehicle also addresses a serious national security issue.

Fuel cell vehicle has the following technology-specific goals for 2010:

- To ensure reliable systems with costs comparable with conventional internal combustion engine/automatic transmission systems, future fuel cell power trains should have Electric propulsion system with a 15-year life capable of delivering at least 55 kW for 18 seconds and 30 kW in a continuous mode, at a system cost of $12/kW peak. [Note this pertains to electrical systems other than the fuel cell such as electric motors, controllers, etc.]

- A durable fuel cell power system (including hydrogen storage) that achieves 60%energy efficiency when operating at peak power and that offers a 325 W/kg power density and 220 W/L operating on hydrogen. Cost targets are $45/kW by 2010, $30/kW by 2015.

- To enable clean, energy-efficient vehicles operating on clean, hydrocarbon-based fuels powered by fuel cells, the goal is Fuel cell

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systems, including a fuel reformer, that have a peak energy efficiency of 45% and meet or exceed emissions standards with a cost target of $45/kW by 2010 and $30/kW in 2015.

To enable the transition to a hydrogen economy, ensure widespread availability of hydrogen fuels, and retain the functional characteristics of current vehicles, the goals are

- Demonstrated hydrogen refueling with developed commercial codes and standards and diverse renewable and non-renewable energy sources. Targets: 70% energy efficiency well-to-pump; cost of energy from hydrogen equivalent to gasoline at market price, assumed to be $1.25 per gallon (2001 dollars).

- Hydrogen storage systems demonstrating an available capacity of 6 wt% hydrogen, specific energy of 2000 W-h/kg [pertains to storage system mass], and energy density of 1100 W-h/L at a cost of $5/kWh.

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Technical goals are not yet available, but the general goals are:

- **Lowering the cost of hydrogen:** Currently, hydrogen is four times as expensive to produce as gasoline (when produced from its most affordable source, natural gas). The Fuel cell vehicle and Fuel Initiative seeks to lower that cost enough to make fuel cell cars cost-competitive with conventional gasoline-powered vehicles by 2010; and to advance the methods of producing hydrogen from renewable resources, nuclear energy, and even coal.

- **Creating effective hydrogen storage:** Current hydrogen storage systems are inadequate for use in the wide range of vehicles that consumers demand.

- **Creating affordable hydrogen fuel cells:** Currently, fuel cells are ten times more expensive than internal combustion engines. The hydrogen FUEL Initiative is working to reduce the cost to affordable levels.

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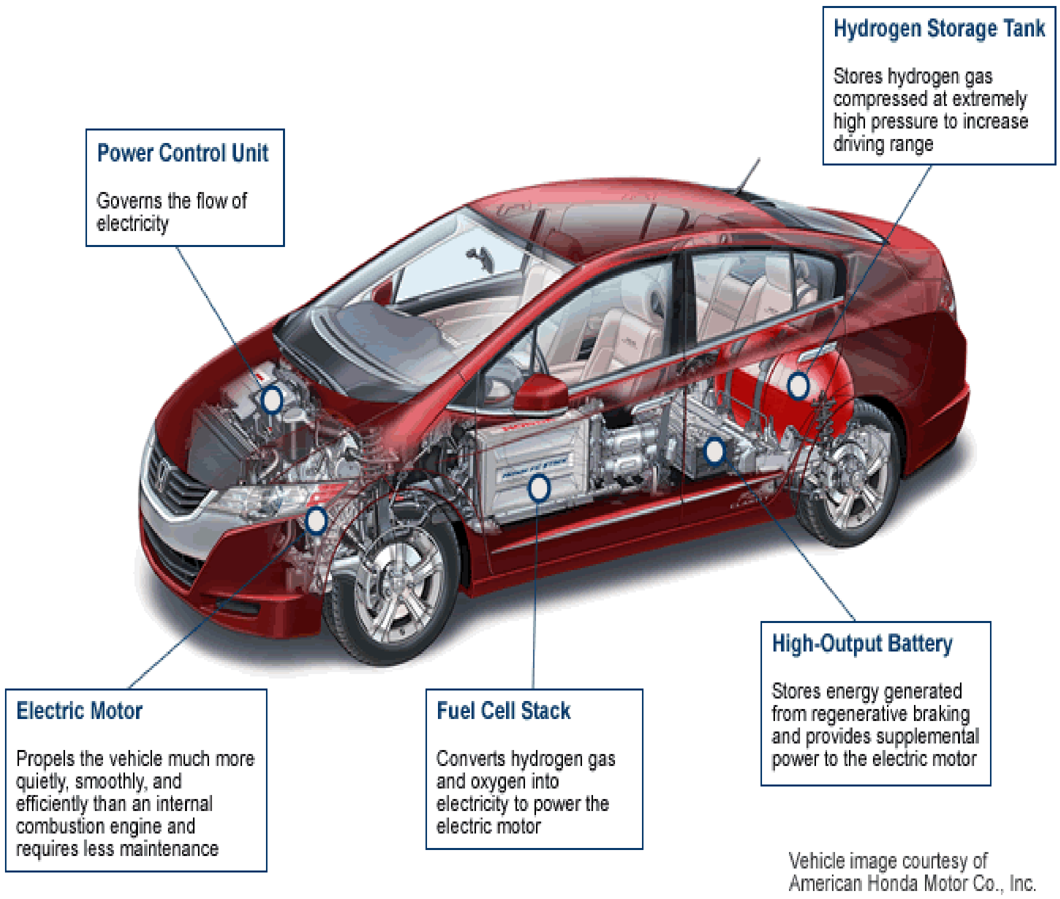

FIGURE 1 FUEL CELL VEHICLE SYSTEM DIAGRAM

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Audi A2H2

HONDA FCX

FIGURE 2 PRESENT FUEL CELL VEHICLE

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1.2 ELECTRIC VEHICLE

An electric vehicle (EV), also referred to as an electric drive vehicle, uses one or more electric motors for propulsion. Electric vehicles include electric cars, electric trains, electric lorries, electric airplanes, electric boats, electric motorcycles and scooters, and electric spacecraft. Electric vehicles first came into existence in the mid-19th century, when electricity was among the preferred methods for automobile propulsion, providing a level of comfort and ease of operation that could not be achieved by the gasoline cars of the time. The internal combustion engine (ICE) is the dominant propulsion method for automobiles, but electric power has remained commonplace in other vehicle types, such as trains and smaller vehicles of all types.

During the last few decades, increased concern over the environmental impact of the petroleum-based transportation infrastructure, along with the spectra of peak oil, has lead to renewed interest in an electric transportation infrastructure. Electric vehicles differ from fossil fuel-powered vehicles in that the electricity they consume can be generated from a wide range of sources, including fossil fuels, nuclear power, and renewable sources such as tidal power, solar power, and wind power or any combination of those. However it is generated, this energy is then transmitted to the vehicle through use of overhead lines, wireless energy transfer such as inductive charging, or a direct connection through an electrical cable. The electricity may then be stored onboard the vehicle using a battery, flywheel, or super capacitors. Vehicles making use of engines working on the principle of combustion can usually only derive their energy from a single or a few sources, usually non-renewable fossil fuels.

A key advantage of electric or hybrid electric vehicles is regenerative braking and suspension their ability to recover energy normally lost during

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