

## International Journal of Innovative Research in Science, Engineering and Technology

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# Environmental Production of Automobiles by Using Alternative Fuel Cells

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**ABSTRACT:** Research and development throughout the world for an effective alternate to the fossil fuel energy has continuously persisted and fuel cell technology is here to stay. The fuel cell is the newest source of energy that offers many benefits over conventional sources of energy such as gasoline power IC engines or coal powered plants.

A fuel cell is a continuous feed primary cell. It uses hydrogen and oxygen to produce electric current with the only by products being heat and pure water. Fuel cells produce DC current and they can be used in the same manner as batteries. They do not require any recharging.

The race between fuel cells and IC engines has reached its mid way and the former has already competed the later due to its higher efficiency, zero emissions of obnoxious gases and usage of renewable sources of energy as fuel. As a coin has two sides fuel cell also has some disadvantages. Some of them at the current time in the nutshell are that they are generally large, expensive and difficulty in the storage and transportation of pure hydrogen. In spite of all these problems the development of fuel cells has geared up due to the green house gases emitted by IC engines. These have created environmental hazards like global warming and ozone layer depletion, which are to a stage of concern now. So we can surely say fuel cells are the power of future. The origin, working and application of fuel cells are reviewed in this paper.

### I. INTRODUCTION

Energy conservation is a major problem in the present scenario. Man is looking for cheaper, cleaner and efficient ways for his various necessities. IC engines have been serving man since many years. This 115 years old dinosaur refuses to die as it gets cleaner and more efficient each year. Though they have come a long way IC engines have to go into the dark if the development of 160 years old. Technology of fuel cell continuous at its current pace.

#### Why all the interest in Fuel Cell Vehicles

- ❖ High potential for improved fuel and vehicle efficiency.
- Double the fuel efficiency
- Reduced CO<sub>2</sub> emissions
- Potential for a very low or zero criteria emissions vehicle.
- ❖ Provide customer needs in an environmentally sound package
- ❖ Potential for a new vehicle concept

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GM HydroGen 1

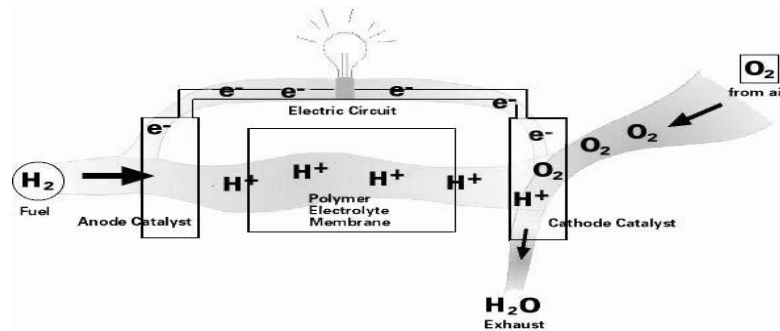


TOYOTA FCHV-3

## II. WORKING OF FUEL CELL

A fuel cell consists of two electrodes sandwiched around an electrolyte. Oxygen passes over one electrode and (or air) enters the fuel cell through the cathode. Encouraged by a catalyst, the hydrogen over the other, generating electricity,

water and heat. Hydrogen fuel is fed into the "anode" of the fuel cell. Oxygen hydrogen atom splits into a proton and an electron, which take different paths to the cathode. The proton passes through the electrolyte. The electrons create a separate current that can be utilized before they return to the cathode, to be reunited with the hydrogen and oxygen in a molecule of water.



A fuel cell system, which includes a "fuel reformer" can utilize the hydrogen from any hydrocarbon fuel - from natural gas to methanol, and even gasoline. Since the fuel cell relies on chemistry and not combustion, emissions from this type of a system would still be much smaller than emissions from the cleanest fuel combustion processes.

## III. TYPES OF FUEL CELLS

Parameter	Alkaline Fuel cell	Phosphoric acid Fuel cell	Molten Carbonate Fuel cell	Solid oxide Fuel Cell	Proton Exchange Membrane Fuel cell
Process	Requires pure hydrogen and oxygen	Complex system design	Uses fuel directly without a fuel processor	Uses relatively impure fuel	Uses solid polymer membrane as an electrolyte
Operating temperature	152°C	200°C	650°C	400 to 1000°C	100°C
Application suitability		Stationary power applications with existing installations	More complex than phosphoric acid fuel cells due to the use of higher temperature and use of molten electrolytes	Suitable for large to very large stationary power applications	Ideally suited for transport and small transport applications
Where used	NASA Apollo space programs	JAPAN, USE AND EUROPE mid to large scale stationary power	US, JAPAN for constant power in large utility applications		NASA Gemini space program

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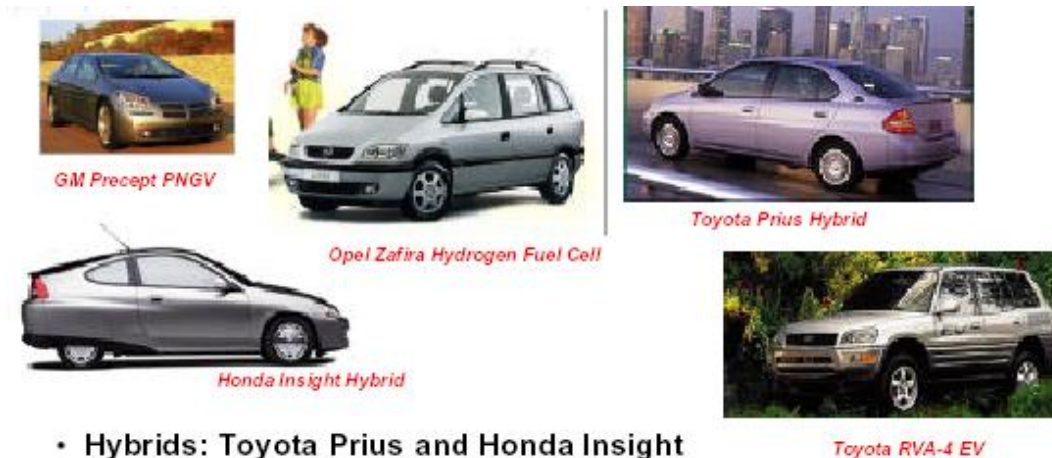
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		and general applications	(1.8 mw prototype tested)		
Technology				Demo stage. very early stages of development	Compact and produce electricity to the size 1 to 250 kW
When introduced	1960s	1970s	2002/03	Demo/evaluation stage	Commercially available

### IV. NEW CONCEPT VEHICLES ARE APPROACHING THE MARKET

#### FUEL FOR FUEL CELLS



- Hybrids: Toyota Prius and Honda Insight
- PNGV Hyper-mileage Cars from Detroit
- Fuel Cell Vehicles

#### Advanced Internal Combustion Engines are Also Improving

Hydrogen	Expected to be near time and long time fuel of choice. Storage and transportation requirements already in place
Hydro-carbon based fuels	Fuel reformer is required to extract hydrogen
Alternatives	Multiple feeds in the intermediate stage hydrogen/methanol/clean petroleum derivatives/natural gas

### V. DIFFERENCE BETWEEN FUEL CELL AND BATTERY

Both the fuel cell and a battery deliver power from a chemical reaction. In a battery the chemical reactants stored within the battery are used up during the reaction and the battery must be recharged or thrown away. But this is not the case in a fuel cell. The reactants are stored externally. Therefore it produces electricity as long as fuel is delivered. A fuel cell is refueled instead of recharging.

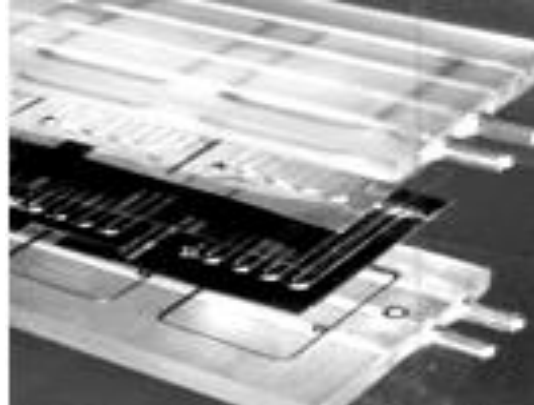
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### NOTE:

- The voltage from a single cell is about 0.7 volts, just about enough for a light bulb. When the cells are stacked in a series, the operating voltage increases to 0.7 volts multiplied by the number of cells



- The power requirement per vehicle is between 5 kW to 15 kW and fuel cells of 50 to 200 kW are already under commercial production. It is expected that small portable with under 3 kW capacity could be in market by 2005 which could trigger a rise in consumption in portable appliances.
- Battery powered vehicles are 80% efficient. But taking into account recharging efficiency is better than today's vehicles but not as efficient as fuel cell vehicles.

### VI. APPLICATIONS

#### Personal

- ◆ Power backup, portable applications
- ◆ Consumer electronics personnel computer
- ◆ Utilities like lawn mowers etc.
- ◆ No noise and air pollution
- ◆ Waste heat produced can be utilized for other purposes.

#### Transport

- ✓ Battery substitution applications.
- ✓ Personnel vehicle engine substitution.
- ✓ Fuel cells being incorporated into buses, locomotives, airplanes etc.,
- ✓ Eliminates emission of green house gases.
- ✓ Provides wide range of speeds as long as fuel is supplied.
- ✓ Lubrication and maintenance problems are eliminated.

#### Public installations

- Used in hospitals, hotels, offices, schools, utility power plants, air port terminal.
- Public utilities like traffic signals.
- Used in wastewater treatment plants and landfills.

#### Military applications

- Saves money and reduces pollution at military installations.
- Saves lives and material by reducing tell tale heat and noise.

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## VII. PROS AND CONS

### Pros

- Cleaner technology due to zero emissions.
- Uses renewable sources of energy as fuel.
- Does not require recharging.
- Quieter than IC engines due to the absence of moving parts.
- No energy losses due to heat transfer, exhaust etc.
- Reduction in efficiency is eliminated due to the absence of combustion.

### Cons

- ❖ Large size nearly 8 sq. ft.
- ❖ Expensive i.e. almost 10 times to that of conventional automobile IC engines.
- ❖ Difficulty in storage and transportation of pure hydrogen.
- ❖ Reduction of efficiency due to the usage of hydrocarbon as a source of hydrogen.
- ❖ Gasoline powered IC engines of today are capable of giving 40 to 50 MPG (miles per gallon) but when used in fuel cell it is 80 MPG but gasoline is also one of the fastest disappearing fossil fuel.

## VIII. CHALLENGES TO BE FACED

### • Technical

- On board processing
- Breakthrough in H<sub>2</sub> generation/storage



### • Economic

- The vehicle and fuel must be developed as a system and must be widely available and affordable

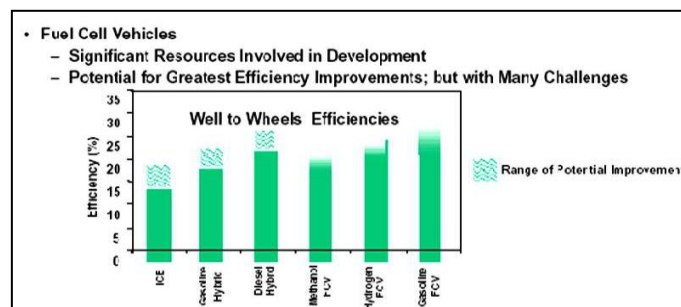


### • Market Driven

- Consumer preferences will determine vehicle and fuel success - convenience, cost, performance



## EFFICIENCY GRAPH



THE ULTIMATE SCENARIO

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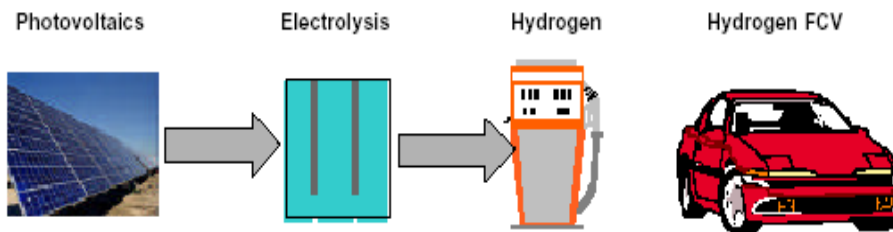
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## IX. CONCLUSION

The IC gasoline engine has been in development for decades. It has made great advances in efficiency, power and cost. However it is nearing the end of line in its equilibrium. The efficiency is leveling off and so is power output.

The FC on the other hand is just beginning on its road to perfection. The fuel cell's efficiency is



### • High cost/multiple technical hurdles

- Large scale, low cost, carbon-free energy
- Hydrogen storage/infrastructure
- Competitive pressures from improved hydrocarbon systems

....A Long-term Solution



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already beyond the efficiency of IC engine and is going to go well beyond where it is today. The road to the perfect fuel cell is just beginning and we have an excellent start.

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