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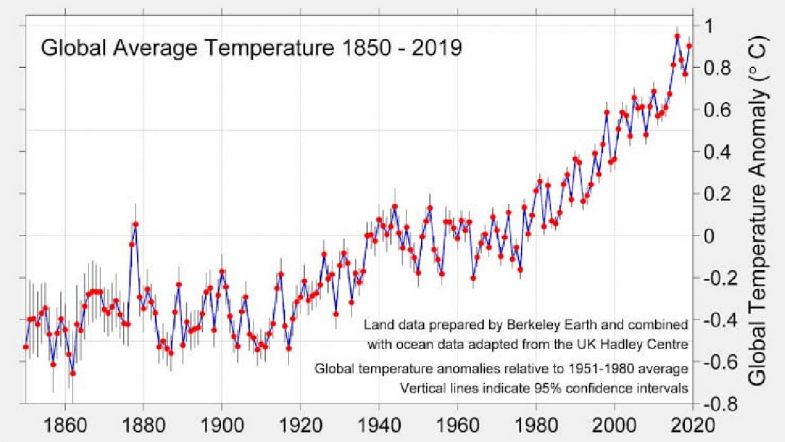
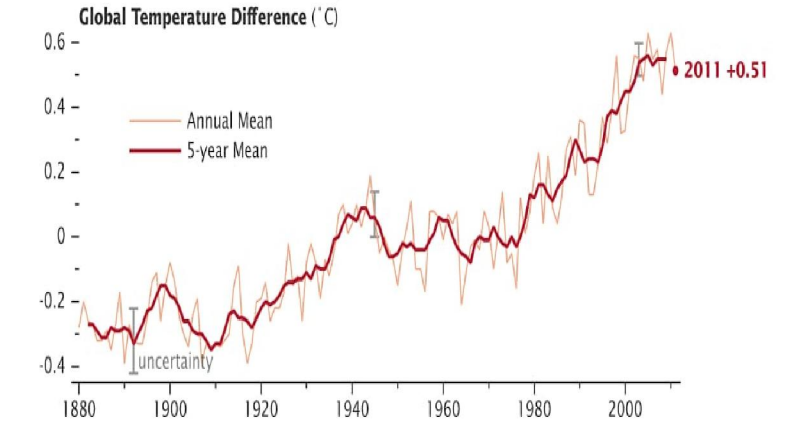
Future Fuel : H_2

Aslam Ali and Shubham Karale

Abstract: *Hydrogen is the fuel of the future. Since hydrogen is an energy carrier that can transform are fossil-fuel dependent economy into a hydrogen economy, which can provide an emissions-free transportation fuel. An ambitious chemistry a students, these researchers understands the importance of a shift to a hydrogen fuel. Hydrogen is an energy carrier that can used in internal combustion engines or fuel cells producing almost no greenhouse gas emissions when combusted with oxygen. And the only significant emission is water vapour. Hydrogen production and storage is currently undergoing extensive research. A solar -hydrogen system can provide the means of a totally emissions-free method of producing hydrogen. Although steam reformation of methane (CH4) level is currently the major route to hydrogen production, and the emissions involved can also be controlled much more efficiently then our current system of transportation fuel. Climate change is a serious issue becoming increasingly evident to much of the population. Rising carbondioxide (CO2) levels have directly contributed to global warming phenomenon. As shown in the below figures. Along with global average temperature and global temperature difference in degree Celsius (°C). .*





The core of the research concerns the advantages of hydrogen and the current progress related to the disadvantages of hydrogen as a transportation fuel. Much work is in progress to initiate a shift from a fossil-fuel to a hydrogen economy.

Keywords: Environment Friendly, Future Fuel, Cost Effective, Convenient to Use, Excellent Option interms of Mileage.

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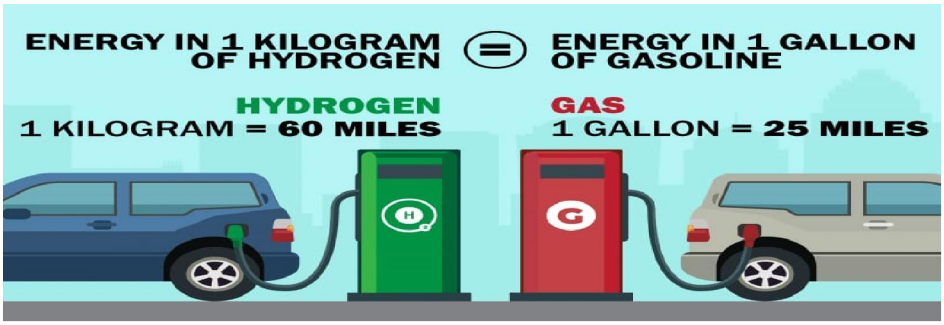
I. Introduction

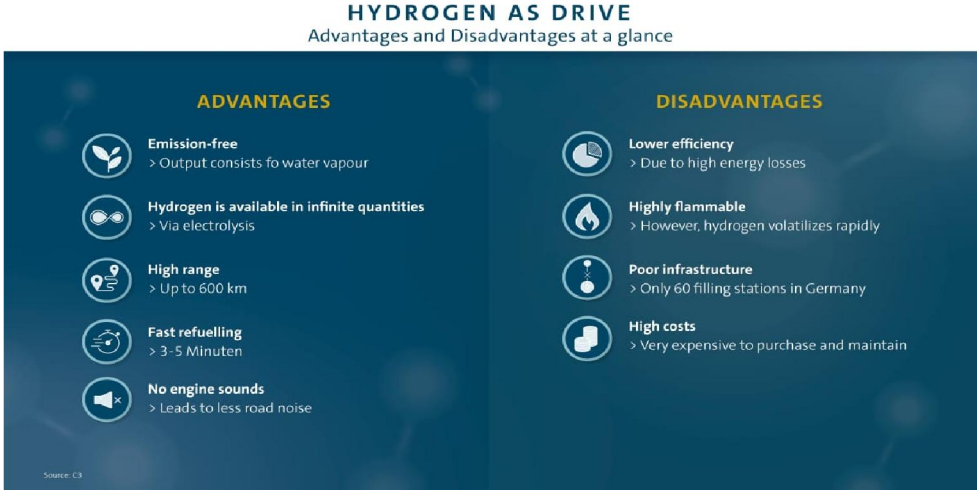
Hydrogen, used as fuel, has a number of attractive features that make it a leading candidate in the search for an alternative to the dwindling and progressively less reliable supply of fluid hydrocarbon fuels. Hydrogen produced by electrolysis using hydro- or nuclear-generated electricity will be available in Canada at prices competitive with other portable forms of energy before the end of the century. This paper examines the use of carbon-free electrolytic hydrogen as a motor vehicle fuel and as a fuel.

Integrating renewable energy into existing industries and infrastructure will not work without hydrogen. To achieve a carbon-free economy, we need to increase the amount of energy from renewable sources like photovoltaic, wind, and geothermal. Simultaneously we need to make this energy available to an existing industry, energy, and mobility infrastructure. Power-to-X solutions based on low carbon and green hydrogen will be a central element to master this challenge successfully.

II. Materials and Methods

Hydrogen is an energy carrier and fuel that, when fed into a fuel cell, can power vehicles and trucks without releasing harmful emissions. Hydrogen and fuel cells can reduce emissions in heavy-duty vehicles, which make up 5% of vehicles on roads, are responsible for more than 20% of transportation emissions, and are the largest contributor to mobile nitrogen-oxide emissions in the World. This research is based on independent research and literature reviews. The various sources of research include recent journal articles from opposing sides of the hydrogen Fuel.





III. Results and Discussion

Hydrogen is an energy carrier that can be produced and converted into energy through a variety of ways. Above table Provides a brief explanation of advantages and disadvantages of Hydrogen as a transportation fuel. Today burning coal and nuclear fission generates 68% of the Indian electricity. Until a dramatic shift is made toward renewable energy sources, the production of hydrogen cannot be emissions free.

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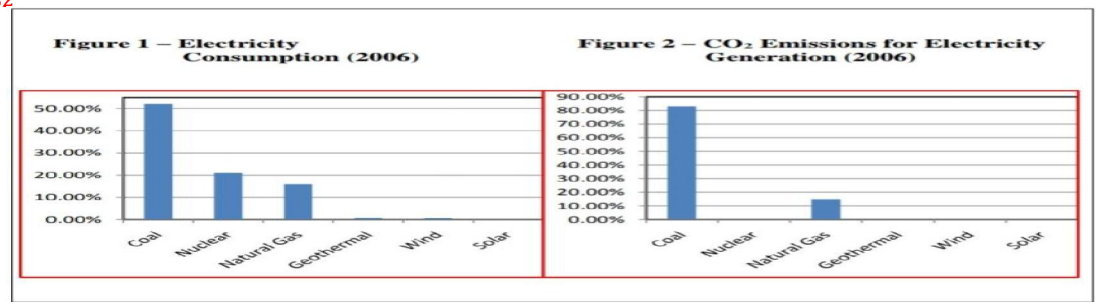

Source: Ministry of Power (India)

Electrolysis of water requires electricity, which can be provided by clean and renewable energy sources. Below Tables provide a summary of the various ways to produce hydrogen.

Table 2a – Various Methods to Produce Hydrogen

Method	Process	Implementation
Steam reforming of methane gas	In presence of nickel catalyst & at 700 – 1100 °C: $CH_{4(g)} + H_2O_{(g)} \rightarrow CO_{(g)} + 3H_{2(g)}$ Next reaction at lower temperature: $CO_{(g)} + H_2O_{(g)} \rightarrow CO_{2(g)} + H_{2(g)}$	Current major source of hydrogen
Hydrogen from coal (Gasification)	At high temperature and pressure: Coal + $H_2O_{(g)} + O_{2(g)} \rightarrow$ syngas Syngas = $H_2 + CO + CO_2 + CH_4$	Current method of mass hydrogen production
Electrolysis of water	Electric current passed through water: $2H_2O_{(l)} \rightarrow 2H_{2(g)} + O_{2(g)}$	Not in widespread use due to cost of electricity
Solar – Hydrogen system	Electric current passed through water: $2H_2O_{(l)} \rightarrow 2H_{2(g)} + O_{2(g)}$	Not in widespread use due to cost of renewable energy sources

Table 2b – Various Methods to Produce Hydrogen

Method	Advantages	Disadvantages
Steam reforming of $CH_{4(g)}$	65 – 75% efficiency Economical (least expensive method) Established infrastructure	Nonrenewable resource Produces CO_2 emissions
Gasification	Large supplies of coal in US Inexpensive resources	Produces CO_2 emissions Carbon sequestration would raise costs 45% efficiency
Electrolysis of water	Depend on electricity source	Input into production may require more energy than released Produces CO_2 emissions if coal is energy source
Solar – Hydrogen System	No emissions 65% efficiency	Expensive

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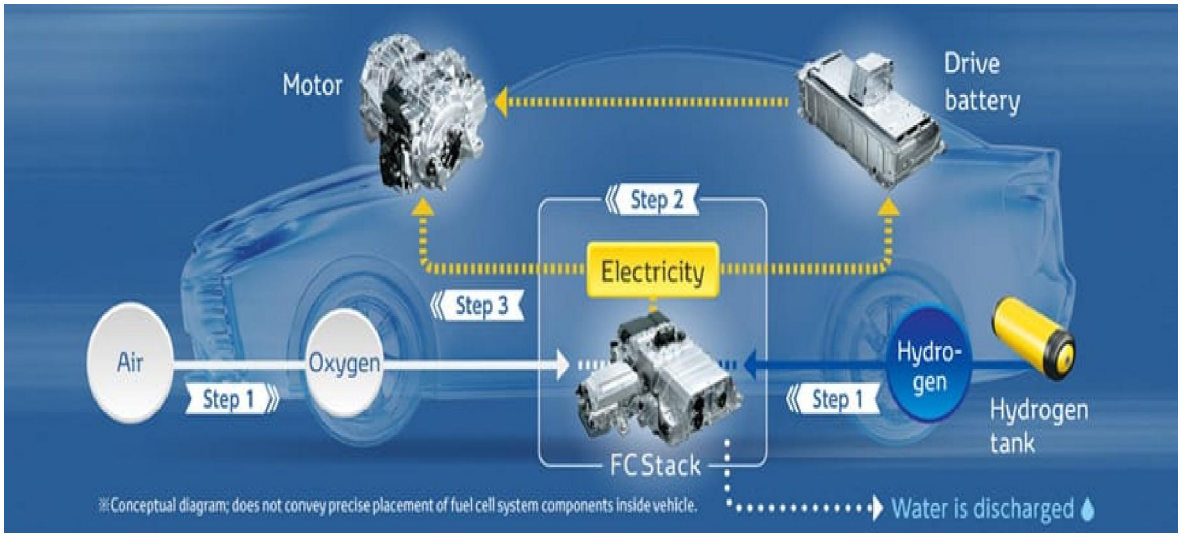
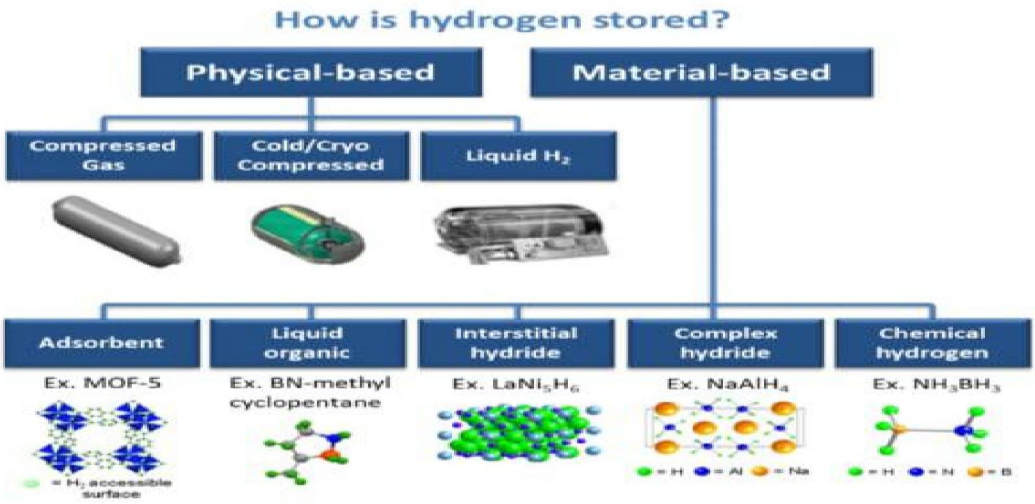


Hydrogen storage and transport is a critical issue involving intense research. The problem is the low density of hydrogen gas. Three possible solutions have been proposed. These potential hydrogen delivery systems include compressed tube trailers, liquid storage tank trucks, and compressed gas pipelines. One major disadvantage of each system is the high capital costs.



Hydrogen can be used as the primary fuel in an internal combustion engine or in a fuel cell. A hydrogen internal combustion engine is similar to that of a gasoline engine, where hydrogen combusts with oxygen in the air and produces expanding hot gases that directly move the physical parts of an engine. The only emissions are water vapour and insignificant amounts of nitrous oxides. The efficiency is small, around 20%. A polymer electrolyte membrane (PEM) fuel cell produces an electrical current from hydrogen fuel and oxygen in the air. Hydrogen is split into hydrogen ions and electrons by a platinum catalyst at the anode. The PEM allows only the hydrogen ions to pass through to the cathode where these ions react with oxygen to produce water. The electrons travel down a circuit creating an electrical current. The fuel cells are arranged in stacks in order to provide enough electricity to power a vehicle. The use of a fuel cell eliminates the nitrous oxide emissions. Furthermore, the fuel cell is 45-60% efficient.

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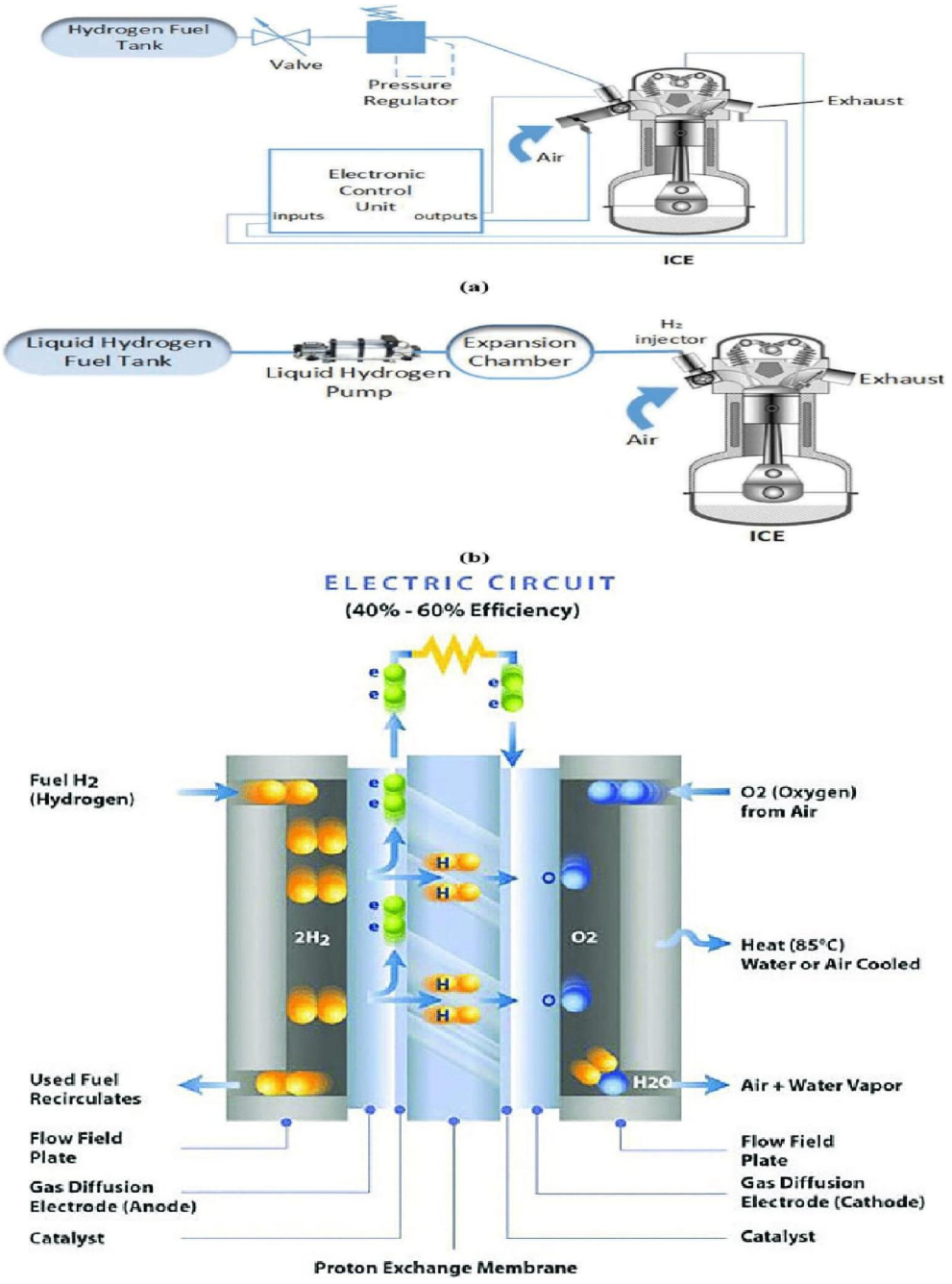

Furthermore, the infrastructure for a hydrogen fuel will come with high capital costs. The transport of hydrogen through underground pipes seems to be the most economical when demand grows enough to require a large centralized facility. However, in places of low population density, this method may not be economically feasible. Hydrogen fuel cells are a promising alternative to current automobile fuels. They essentially combine the energy density and the convenience of liquid fuels with the clean and efficient operation of electric vehicles. Although certain aspects of the technology such as efficient on-board storage still require some improvement, there are no reasons why hydrogen couldn't become an equally convenient and attractive transportation fuel as diesel or gasoline are today.

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