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HYDROGEN FUEL CELL CARS AS A PRACTICAL ALTERNATIVE TO BATTERY CELLS

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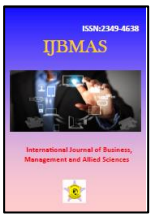

ABSTRACT

In the last 3 to 4 years, we have seen a tremendous demand for renewable fuel sources in automotive technology, which has resulted in a notable shift towards sustainability. In this article, I try to understand which is the most practical alternatives to conventional gasoline. In addition, the viability of hydrogen vehicles replacing electric vehicles or can both the technologies work in tandem with each other. This article is trying to understand whether hydrogen vehicles are more likely to enhance rather than replace electric vehicle technology in the short to medium future

KEY WORD: Hydrogen Fuel Cell Vehicles, Battery Electric Vehicles, greenhouse gases, alternatives to conventional gasoline.

1. INTRODUCTION AND LITERATURE REVIEW

In the last 3 to 4 years, we have seen a tremendous demand for renewable fuel sources in automotive technology has result there is a notable shift towards sustainability. The modern transportation system, which mostly uses internal combustion (IC) engines, is a major contributor to the global emissions of greenhouse gases. Battery Electric Vehicles (BEVs) and Hydrogen Fuel Cell Vehicles (HFCVs) are two promising technologies that researchers are actively pursuing as potential solutions for decarbonization in order to address this urgent issue. This article is trying understand which is the most practical alternatives to conventional gasoline. In addition, the viability of hydrogen vehicles replacing electric vehicles or can both the technologies work in tandem with each other.

1.1. Electric vehicles.

All-electric vehicles, also referred to as battery electric vehicles (BEVs), have an electric motor instead of an internal combustion engine. The vehicle uses a large traction battery pack to power the electric motor and must be plugged in to a wall outlet or charging equipment, also called electric vehicle supply equipment (EVSE). Because it runs on electricity, the vehicle emits no exhaust from a tailpipe

and does not contain the typical liquid fuel components, such as a fuel pump, fuel line, or fuel tank. (https://afdc.energy.gov/vehicles/how-do-all-electric-cars-work)

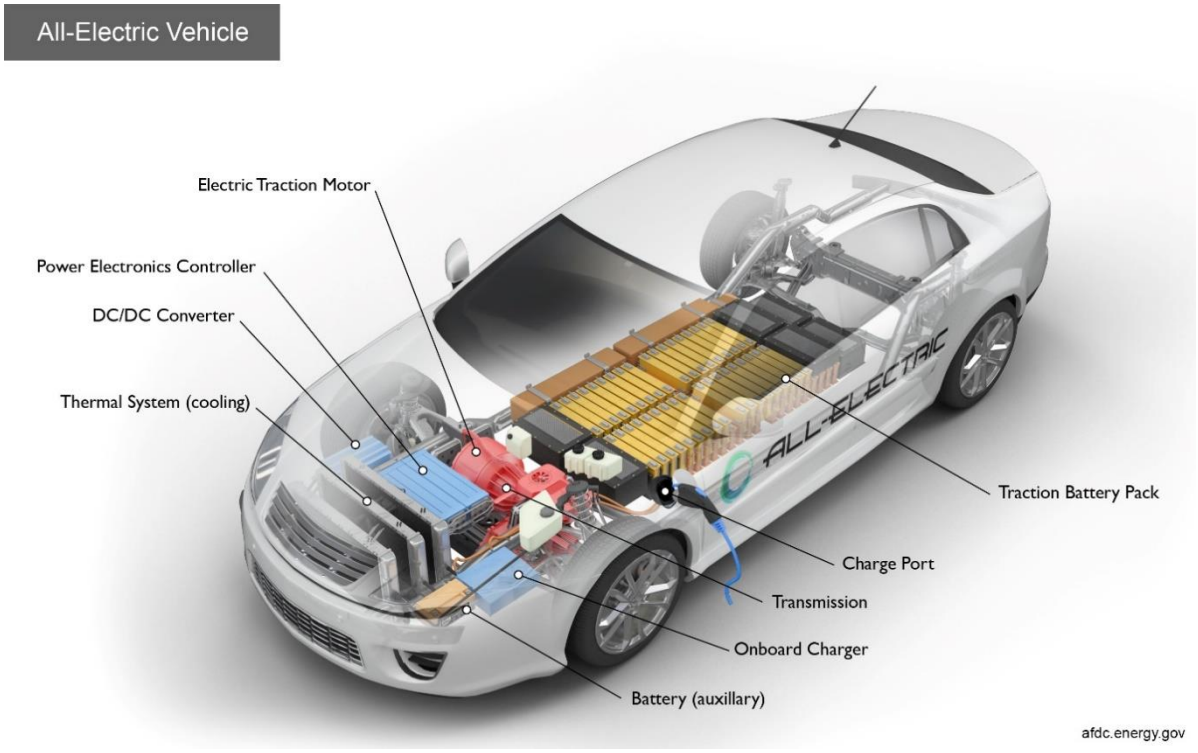

Fig1: All Electric Vehicle (Source: afdc.energy.gov)

Due to its reputation for producing zero tailpipe emissions, BEVs help to lower greenhouse gas emissions and air pollution. The vehicle must be connected to an external power source, such as a wall socket or specialized charging station, in order to begin the charging process. The driving range of BEVs varies depending on the capacity of their batteries. But new developments in battery science have led to improvements in both charging speed and range, making them increasingly viable alternatives to traditional gasoline-powered cars.

1.2. Pros and Cons of BEVs

1.Pros: Cost per mile is significantly lower than for a gasoline-powered vehicle, quiet operation, instant torque from the electric motor, zero emissions from the vehicle, extensive electric infrastructure, and the ability to generate some electricity from renewable sources.

2.Cons: Expensive batteries, long charging times, short range, and the usage of coal—a dirty-burning fuel—in much of the nation's electrical production. Public chargers are hard to come by and high-voltage home chargers can get pricey.

1.3. Electric Vehicles Using Hydrogen Fuel

Like all-electric vehicles, fuel cell electric vehicles (FCEVs) use electricity to power an electric motor. In contrast to other electric vehicles, FCEVs produce electricity using a fuel cell powered by hydrogen, rather than drawing electricity from only a battery. During the vehicle design process, the vehicle manufacturer defines the power of the vehicle by the size of the electric motor(s) that receives electric power from the appropriately sized fuel cell and battery combination. Although automakers could design an FCEV with plug-in capabilities to charge the battery, most FCEVs today use the battery for recapturing braking energy, providing extra power during short acceleration events, and to smooth out the power delivered from the fuel cell with the option to idle or turn off the fuel cell during low power needs. The amount of energy stored onboard is determined by the size of the hydrogen fuel

tank. This is different from an all-electric vehicle, where the amount of power and energy available are both closely related to the battery's size. (https://afdc.energy.gov/vehicles/how-do-fuel-cell-electric-cars-work)

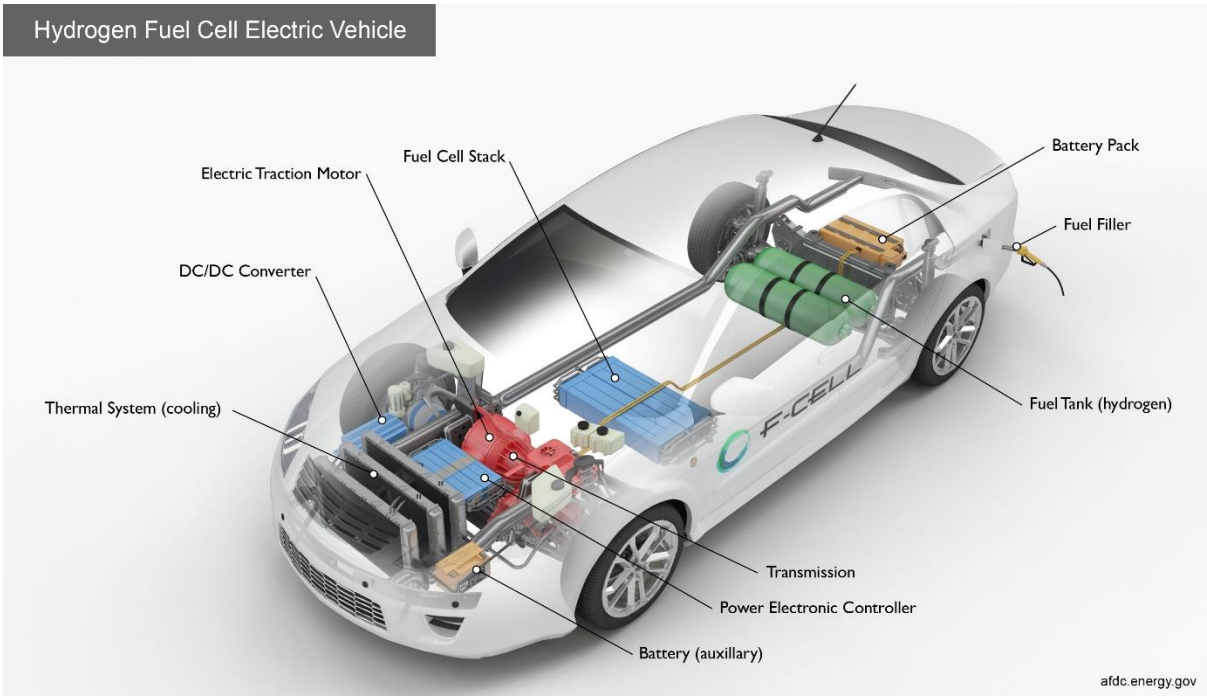

Fig 2: Hydrogen Fuel Cell Electric Vehicle Source (Source: afdc.energy.gov)

HFCVs are divided into two categories: Fuel Cell Electric Vehicles (FCEVs), which produce only water vapor as a byproduct while using hydrogen fuel cells to create electricity for the electric motor used for propulsion. They can be refuelled rapidly and have extended driving ranges. Additionally, fuel cell technology is combined with an extra energy storage component, usually a battery, in Hybrid Fuel Cell Electric Vehicles (HFC-HEVs). The battery is charged by the fuel cell, which also generates electricity to run the motor during acceleration. Based on particular requirements and concerns for vehicle design, one can choose between FCEVs and HFC-HEVs.

1.4. Pros and Cons of HFCVs

1.Pro: Just water vapor is released from vehicles Almost twice as fuel-efficient as gasoline-powered automobiles. Renewable energy can be used to create hydrogen, which is a plentiful resource. Fast Refuelling compared to BEVs. Applications are not limited to transportation, they provide the energy for trains, ships, buses, and trucks.

2.Cons: The cost of this space-age technology is high. Extremely high-pressure hydrogen storage must be installed on board for an acceptable range. Rest stops are few. Transporting hydrogen is exceedingly costly, and the necessary infrastructure is not currently in place. At the moment, non-renewable natural gas is used to make hydrogen fuel, a process that results in significant CO2 emissions.

1.5. Future of hydrogen fuel cell vehicles

The general belief today is that battery electric powertrains are the way of the future for passenger and short-range vehicles (such inner-city delivery vans). A survey of the present patent activity in this subject indicates that while hydrogen fuel cell electric vehicles are also thought to have uses in this industry, innovation is mostly focused on utilizing hydrogen fuel cells for longer-distance transport.

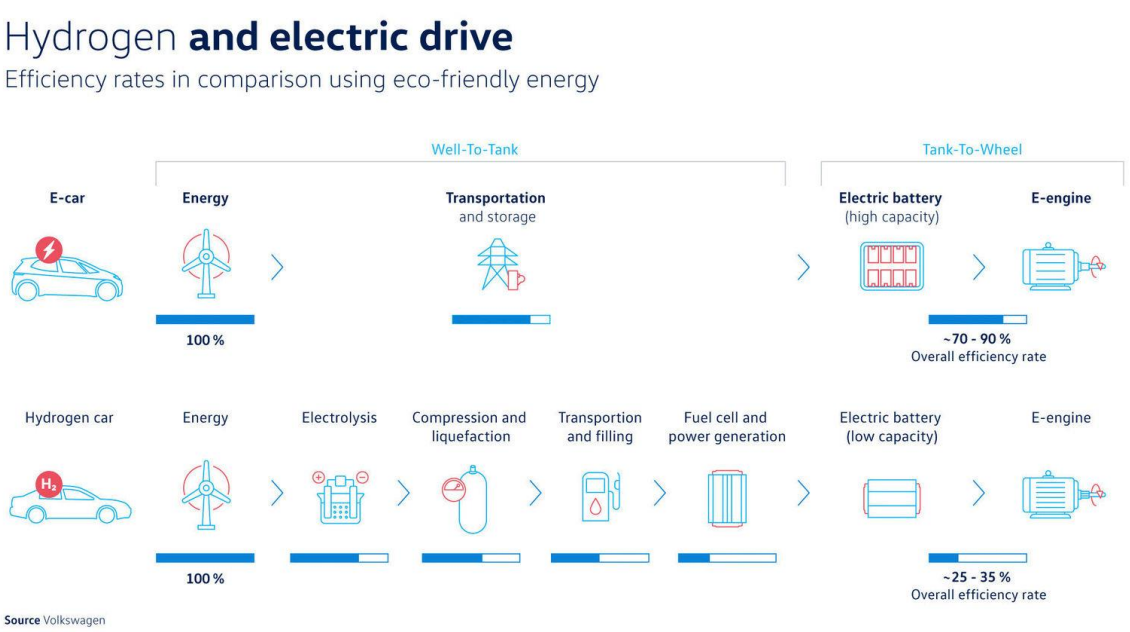

Fig 3: Hydrogen and Electric Drive Efficiency Rate Comparison using Eco-friendly Energy Source: Volkswagen AG (https://www.volkswagen-newsroom.com)

Let's say saving the environment is one of your top priorities. In that instance, while taking into account the stages involved in power generation and propulsion, battery electric vehicles are significantly more energy efficient than hydrogen fuel cell vehicles. Electric vehicles that run on batteries experience an energy loss of 8% while being transported to their batteries. When the electrical energy is transformed to power the electric motor, another 18% percent is wasted. Depending on the travel cycle, EV efficiency ranges from 60 to 73%, according to fueleconomy.gov. However, EV energy efficiency can surpass 77% when regenerative braking is incorporated. (https://www.fueleconomy.gov/feg/atv-ev.shtml)

Electrolysis is the technique used to create hydrogen (with no emissions). The process of making hydrogen wastes between 20 and 30 percent of energy. After that, 10% more hydrogen must be lost during compression and storage. And last, when the hydrogen is turned into energy, another thirty percent is wasted. About 30 to 40% of the initial energy utilized is still available to you. (https://www.fluxpower.com)

Stated otherwise, a battery electric vehicle can generate 800 W of energy for every 1000 W of electrical supply, whereas a hydrogen fuel cell vehicle can only generate 380 W, or less than half that amount. If you're hoping for a greener future, there's a huge inefficiency, and that doesn't even take into consideration the fact that 95% of hydrogen is now produced using fossil fuels. Although hydrogen fuel cell electric vehicles have certain benefits, their general adoption and integration into transportation will depend on how well infrastructure, costs, and efficiency are addressed.

1.6. Conclusion:

Based on my research, I've come to the conclusion that although green hydrogen is receiving greater attention as a possible clean energy source, particularly for certain uses, in the short to medium future, it's more likely to enhance rather than replace electric vehicle technology. It is anticipated that the landscape of transportation will be varied in the future, combining several technologies such as battery electric, hydrogen fuel cell, and possibly some that have not yet been created or marketed.

BIBLIOGRAPHY

[1]. The Future of Hydrogen - https://www.iea.org/reports/the-future-of-hydrogen

[2]. Overcoming the Range Limitation of Medium-Duty Battery Electric Vehicles Through the Use of Hydrogen Fuel Cells, Eric Wood, Lijuan Wang, Jeffrey Gonder, and Michael Ulsh, *SAE International Journal of Commercial Vehicles* (2013)

[3]. García-Herrero, A., Tagliapietra, S., & Vorsatz, V. (2021). Hydrogen Development Strategies: A Global Perspective. [Online]. Bruegel. Available at: https://www.bruegel.org/blog-post/hydrogen-development-strategies-global-perspective (Accessed on November 23 2022).

[4]. Clean hydrogen: smoke screen or the future of energy?, By Goda Naujokaitytė (03 Sep 2021)- https://sciencebusiness.net/news/clean-hydrogen-smoke-screen-or-future-energy

[5]. Various articles from leading Newspapers, Journals and Magazines