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9. Advanced Battery and Fuel Cell Development for Electric Vehicle

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ABSTRACT:

It is becoming increasingly difficult for the global automotive industry to decarbonize transportation due to numerous factors, including the rise in greenhouse gas and particulate emissions that affect both the climate and human health, the rapid oil depletion, issues with energy security and dependence from foreign sources, and population growth.

Our society has been dependent on oil for more than a century, and substantial advances in low- and ultra-low carbon technology and vehicles are urgently needed. Vehicles powered by fuel cells are gradually displacing cars with internal combustion engines.

There is still a long way to go before electric vehicles take over the global automobile market, but today's electric vehicles are nearly entirely powered by lithium-ion batteries.

In addition to government backing, widespread use of electric vehicles necessitates the development of high-performance and low-cost energy storage technologies, including batteries and other electrochemical. Here, we present a complete assessment of several batteries and hydrogen fuel cells that have the greatest economic viability.

KEYWORD:

Fuel Cell, BV, GM, Electric Vehicle, EV.

Introduction:

Clean, safe, reliable, and secure energy supplies are essential for a world with a high standard of living. For human activities to co-exist with a sustainable environment, energy supply systems must provide some social needs at reasonable prices while also having minimal negative environmental impacts.

Climate change mitigation, toxic pollution reduction, and the replacement of dwindling oil supplies are all dependent on the implementation of these technologies. Environmental, economic, and public health risks result when an energy system is unable to achieve these standards. [1]

Although first introduced as early as the 1800s1, electric vehicles (EVs) have only began to be widely accepted since the start of the present decade. Global EV sales have soared from less than 10,000 in 2010 to 774,000 in 2016, surpassing mil-lion cumulative sales.

Vehicle electrification is increasingly viewed as the key decarbonization pathway for practically all road-based transportation [2]. Several governments have announced plans to restrict the sale of internal combustion engine cars (ICEVs), which will necessitate the use of electric vehicles (EVs).

Concerns about global warming, the depletion of fossil fuels, and smog in cities necessitate more environmentally friendly modes of transportation. Biofuels, hybrid electric vehicles, plug-in hybrids, battery electric vehicles, and hydrogen fuel cell vehicles are all newer, cleaner choices for passenger cars and delivery vans, and they are putting pressure on the current transport fuel options. fuel cells are any electro-chemical devices that directly convert chemical energy from any fuel into electrical energy.

Fuel cells differ from batteries in that the reactants are fed directly from external sources rather than being stored internally[3]. They do not participate in the process in fuel cells like batteries, which are often consumed irreversibly in a primary cell and can be repaired reversibly in a secondary cell.

There are numerous applications for fuel cells, including spacecraft and stationary applications like emergency power generators, where they are already in operation. [4]

Fuel Cell Electric Vehicles:

Hydrogen is the source of power for FCEVs (fuel cell electric vehicles). They are more efficient than conventional internal combustion engines and release no exhaust emissions—they simply emit water vapour and warm air.

A separate subsystem provides "fuel" to the electrode, which is not present in the electrode itself. As long as the fuel and oxidant are provided in suitable quantities to the fuel cell, electrical energy can be generated. The problem is to ensure that all cells of the stack receive the same amount of fuel and that (the waste) products are adequately removed. [5]

Automotive Technology Development:

For financial, ecological, and political reasons, increasing demand for oil and CO2 generation proportional to the predicted number of vehicles is not sustainable. Every implementation strategy must thus strive to replace fossil fuel as a source of automotive energy. As depicted in Figure 1, one technique employed by General Motors is the electrification of the automobile, or the substitution of alternate energy carriers for gasoline. As a result, we'll use less fuel, emit fewer greenhouse gases, and have better energy security because we'll have a wider variety of energy sources to draw upon. [6]

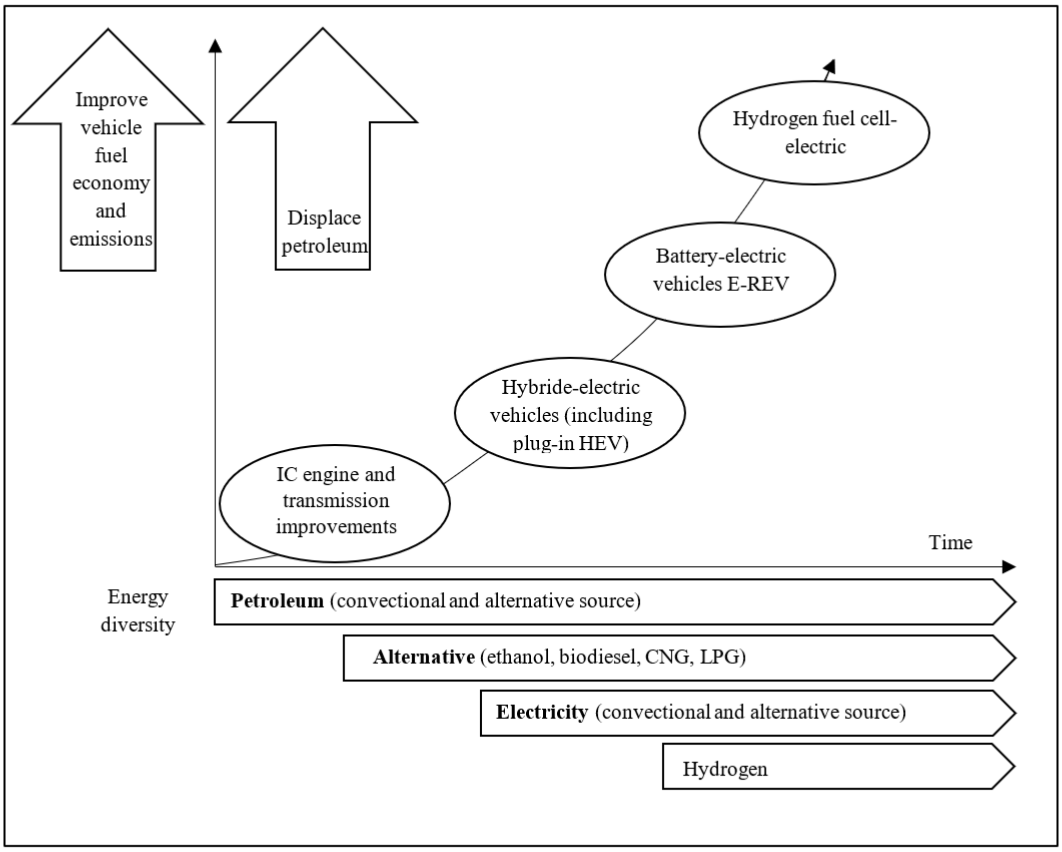

Fig. 1: GM's advance propulsion strategy

Review of Literature:

Alaswad et al. [7] claim that a considerable amount of the fuels utilised in heat engines are lost in exhaust gas and friction losses. This year's shipments of fuel cell systems increased significantly as compared to 2012. Approximately 45,700 units were sent in total in 2012, with the vast majority going to businesses in the transportation industry. FCEVs (fuel cell-powered electric cars) were mass-produced in vast numbers during this time period. Hyundai built the IX35 and Toyota built the Mirai, both FCEVs, although they were made by different companies.

This study examines the use of fuel cells in the automotive industry, as well as some recent modifications to the technology, and compares this to battery-powered cars.

Achour et al [8] created a representative tool to assist a local authority in identifying traffic-related air quality issues. As the transportation industry faces some difficulties, the majority of the findings from these studies were put to use in industrialized countries. Invented in the 1800s by Sir William Groove in England, the fuel cell was first used in spacecraft in the 1950s after considerable research by Nasa.

To begin, Dias et al [9] say that most automobile systems may be divided into three broad categories: ICEV (internal combustion engines), hybrid electric automobiles, and all-electric vehicles.

Batteries, ultracapacitors, and fuel cells are the energy sources used by all electric cars. The hybrid system is created through the combination of an ICEV and an AEV power source.

An approximate 43 kg tank system is required to achieve 500 km of range with today's technology, according to Eberle and Rittmar [10]. This tank system needs a volume of less than 50 litres . Additionally, they stated that a fuel zero-emission car requires a system with a mass of about 125 kg (based on a 700bar compressed gaseous hydrogen vessel).

Objectives:

- To study latest advances in electric cars technology and their design specifications.
- To compares the technologies of the electric cars
- To study energy consumtion and carbon dioxide emission in different sector
- To Study evolution of EV Sales

Research Methodology:

It's a descriptive research based on secondary data obtained from a range of sources, including books, educational materials, journals, scholarly papers, and government publications, as well as printed and online reference materials, to name a few.

Result and Discussion:

According to current statistics, transportation accounts for roughly 55% percent of global energy consumption and 30.9 % of carbon dioxide gas emissions. It is the largest consumer of energy on the planet. Dietary energy consumption patterns over the last few years are depicted on Figures 2 and 3 by Das et al. Fig. 1 and 2 show what will happen if the current situation isn't handled carefully in the future. [11]

The use of electric cars as an alternative to the use of fossil fuel is currently being studied and researched. Electric automobiles are viewed as environmentally benign and are expected to contribute in the process of lowering hazardous emissions into the atmosphere. [12]

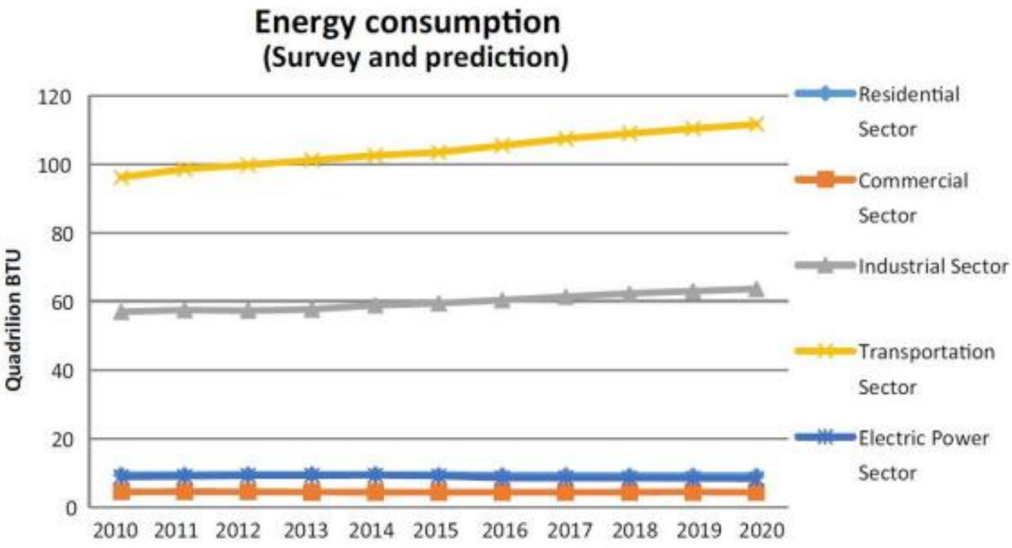

Fig. 2: Consumption of energy in different sectors

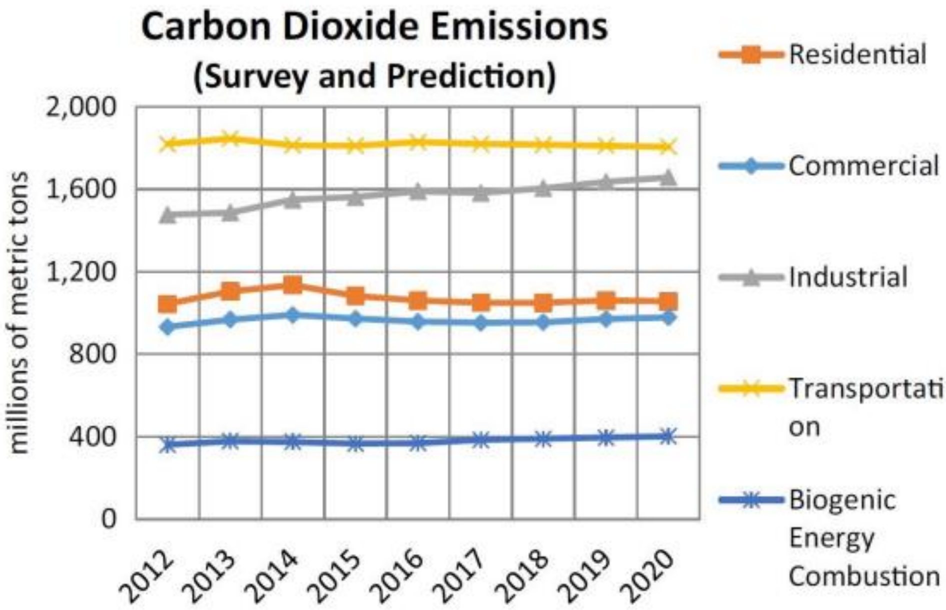

Fig. 3: Emission statistic of carbon dioxide statistics in different sectors

A worldwide temperature increase of no more than 1.75 ° C is predicted by the International Energy Agency (IEA) in its scenario3, which is depicted in Figure 4. The "Beyond 2 Degrees Scenario" (B2DS) predicts 1.8 billion EV sales and an 86 % EV market share by 2060. There are only roughly 2 million vehicles on the road now, with a market share of 0.2 %, which illustrates the current state of globalisation in Fig. 1. [13]

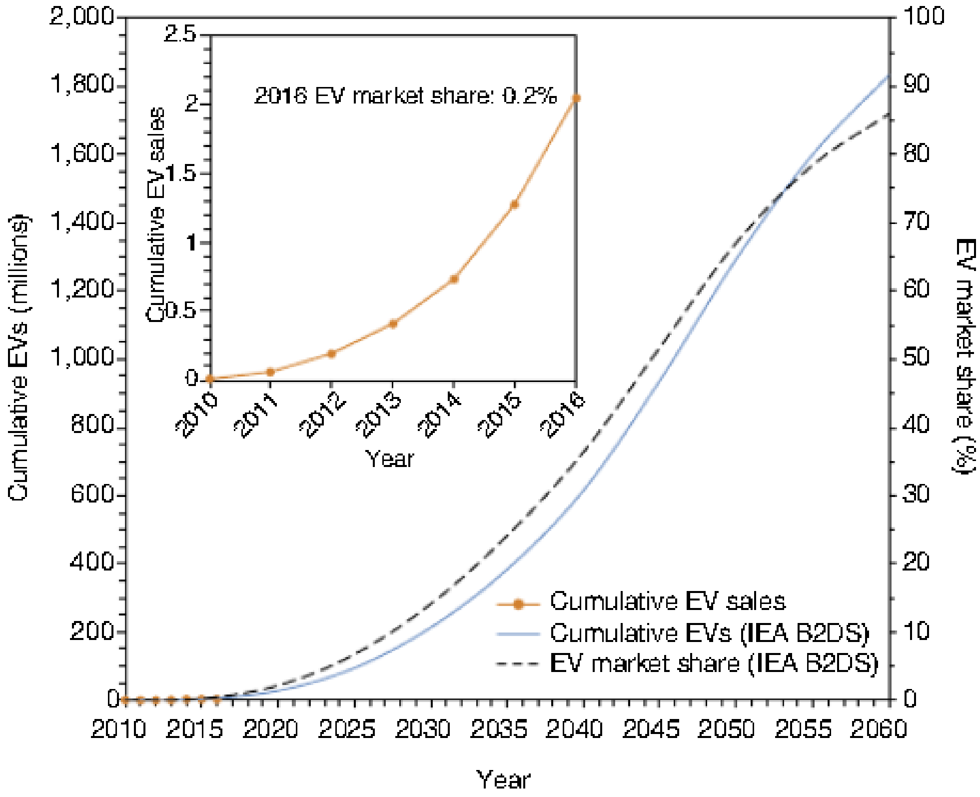

Fig. 4: Evolution of cumulative EV sales and EV market share prescribed in the IEA's 'Beyond 2 Degrees Scenar

Conclusion:

There has been a lot of progress in electrochemical storage devices throughout the previous decade, and the near future holds promise for many further breakthroughs. Cost, durability and energy density are the primary areas where improvements are required to compete with traditional fossil fuels. During the early commercialization phases, all of these cars will be more expensive than equivalent conventional vehicles; consequently, the assistance and cooperation of all relevant stakeholders is vital during this initial phase. The most important actors consequently are principally car manufacturers, energy firms, and the governments. But even the end user should welcome these revolutionary automobiles, despite the initial cost, considering the lower fuel consumptions and the environmental concern.

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