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Are Ev's Eco-friendly like we assume?

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Abstract

Pollution of the environment is currently a global concern. The over a century-old automobile industry is gearing up for transformation. Toxic emissions from internal combustion engines are one of the primary air pollutants. In order to mitigate the effects of fossil fuel emissions and address environmental concerns, electric vehicles are being promoted aggressively worldwide. Various governments are encouraging people to switch to EVs by incentivizing the transition. Previous studies indicate that the high cost of electric cars, non-availability of charging infrastructure, time, and anxiety impede consumer adoption. However, several studies reveal switching from internal combustion engines to motor-based electric vehicles isn't as environmentally friendly as it seems. The current paper tries to critically analyze how electric vehicles are not ''greener'' than we assume and concerns over electric vehicles and pollution that occur in a period of production and later too. The paper even discusses clean energy and how the world is working towards concern forthe environment.

Keywords: - Environment, Pollution, Electric vehicle.

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Introduction

Transportation has always been a crucial aspect in widening the scope of living, communication, knowledge, innovation, culture, language, commerce, etc. One of the greatest inventions of mankind is considered to be the wheel, which changed the course of the world in different ways. In ancient days the medium of mobility was different but some 3500 BC years ago it changed with the introduction of the wheel and axle. In recent years the way of transportation paradigm has been shifting, emergence of E-mobility and advancement in technology have boosted the development of mobility further ahead. With the gift of advantages in mobility, it comes with a few drawbacks like pollution and carbon footprint. The transportation sector contributes about a quarter of GHG (Green House Gas) emissions. CHG are compounds of gases that trap heat or longwave radiation in the atmosphere. Their presence in the atmosphere makes the Earth's surface warmer. 1992 Kyoto Protocol Summit of United Nations Framework Convention on Climate Convention listed these six major gases as CHG which are Carbon dioxide (CO2), Methane (CH4), Nitrous oxide(N2O), F-gases (hydrofluorocarbons and perfluorocarbons) and Sulphur hexafluoride (SF6) called as Kyoto basket. Globally, the primary source of greenhouse gas emissions are Electricity and Heat (31%), Agriculture (11%), Transportation (15%), Forestry (6%) and Manufacturing (12%). Energy production of all types accounts for 72 % of all emissions. As automobile industry is one of the primary contributing sources of CHG which is by countries like China emitting 25.9 percent, the USA at 13.87 percent followed by India at 7.45 percent. Several conventions and summits have been conducted by the UN over decades and the main motto is to reduce carbon emissions and keep the global temperature under control while it is getting out of hand. Glaciers in the poles are melting, seasons are affected, a wide range of flora and fauna is diminishing, habitat is lost, sea levels are rising and the ozone layer is depleting year by year. To overcome every such problem world is fighting together with a common cause. In such programs, one is the promotion and usage of electric vehicles. Every country in the world is devoting attention to switching to electric-run cars, buses, trains, and every possible public transport. India's commitment to containing pollution and reducing its carbon footprint is also increasing. The country is preparing to shift towards EVs by 2030. The government desires the car manufacturers to migrate to EV production, which will curtail the oil

bill by US $60 billion, cut emissions by 37 percent, and reduce the dependence on the imports of fuel. The Eight Clean Energy Ministerial in 2016, in its campaign, adopted the slogan "The EV30@30". The member countries reaffirmed their commitment to EV production. The aim was to attain a total market share for the respective categories, namely passenger cars, light commercial vehicles, buses, and trucks by 2030.(IEA, 2016). The government of India has announced that all cars need to be electric by 2030 and manufacturing to reach 30% of the total fleet available in India by 2030. The Society of Indian Automobile Manufacturers (SIAM,2017) followed this with their white paper stating that EVs would make up to 40 percent of new car sales by 2030 and 100 percent by 2047. The milestone date coincides with 100 years of the country's independence. The shift towards EVs in India is imperative shortly, though not imminent. Several cities are victims of unplanned urbanization and high pollution. Pushing towards switching to EVs results in the bombardment of infrastructure development, and production and following impacts on the economy and the health of society. The main component of the electric vehicle is the rechargeable batteries and infrastructure to provide electricity through the grid. The primary aspects to be considered are how the demand is met for elements needed in EVs and the usagethem.

History

By definition, an electric vehicle, or EV, will use an electric motor for propulsion rather than an internal combustion engine. Who invented the very first EV is uncertain, as several inventors have been given credit. In 1828, Hungarian Anyos Jedlik invented a small-scale model car powered by an electric motor that he designed. Between 1832 and 1839, Robert Anderson of Scotland invented a crude electric-powered carriage. In 1835, another small-scale electric car was designed by Professor Stratingh of Groningen, Holland, and built by his assistant Christopher Becker. In 1835, Thomas Davenport built a small-scale electric car and he was the first person to build the first American-built DC electric motor (Bellis, 2019). Thomas Davenport and Robert Davidson together invented more successful electric road vehicles around 1942 but the only drawback was the batteries were nonrechargeable. Frenchman Gaston Plante invented a better storage battery in 1865. Over the years better capacity storage batteries were needed for

the electrical vehicles to become practical. Western countries like France and England started focusing on electric vehicles. After 1895 Americans started to devote attention to EV. A.L. Ryker and Williamson built passenger vehicle which is considered as first real and practical EVs. In 1899, a Belgian built a racing car named "La Jamais Contente". In 1916 Woods Motor Company of Chicago invented a hybrid car that had both an internal combustion engine and an electric motor. In 1908 Henry Ford Company started production of internal combustion engines which were more affordable and widely available and the discovery of oil and dependency on gasoline caused the decline in the popularity of Electric vehicles.

Types of Electric Vehicles

Battery Electric Vehicles (BEV): are also known as All-electric vehicles. These types of vehicles use technology that runs entirely on a battery-powered electric drivetrain. The electricity used to drive the vehicle is stored in a large battery pack which Can be charged by plugging it into the electricity grid. The charged battery pack then provides power to one or more electric motors to run the vehicle. These are more efficient compared to hybrid and plug-in hybrids.

Hybrid Electric Vehicle (HEV): these are also known as series hybrid or parallel hybrid. These type of vehicles uses both the internal combustion engine and battery-powered motor. The engine gets energy from fuel, and the motor gets electricity from batteries. The transmission is rotated simultaneously by both the engine and the electric motor. These vehicles are not as efficient as fully electric or plug-in hybrid vehicles.

Plug-in Hybrid Electric Vehicle (PHEV): these also have both internal combustion engines and electric motors. Batteries can be recharged through regenerative braking or an external source of power. PHEVs are more efficient than HEVs but less efficient than BEVs.

Fuel cell Electric Vehicle: these types of vehicles use electric energy produced from the chemical energy within the powertrain setup.

Objectives

1) To know whether electric vehicles are pollution-free mobility.
2) To understand the reality of eco-friendly or green-vehicle notion.

Research Methodology

For the present paper, the data is collected from various secondary sources like reports, articles, published papers, online blogs, and web sources. by comparing and reviewing the data from such sources results are drawn.

General Discussion

Many new vehicle technologies have the goal of steering automobiles away from dependence on fossil fuels, and EVs ought to be the solution for it. Electric vehicles are promising technology in drastically reducing the environmental burden of road transport. This EV technology is being identified as a key technology to the solution of pollution from Internal Combustion engines or fuel-run vehicles. Last century inventions and discoveries of oil have brought us to an era of environmental crisis. The resulting impacts were air pollution both indoor and outdoor, acid rain, water pollution, noise pollution, hazardous waste polluting the soil, and leakages in water bodies affecting aquatic creatures. India is the seventh-largest country by land mass and second-largest by population, the fifth largest economy currently has the fifth largest car market in the world, and has the potential to become one of the top three shortly with about 40 crores in need of mobility solutions by the year 2030. According to research back in 2015, it is predicted that oil will go extinct in the next 50 years. However, as per the Paris Agreement, the increase in number of automobile customers shall not imply an increase in the consumption of conventional fuels. To ensure a positive growth rate towards achieving India's Net Zero Emission by 2070. And the assumption is made and put forward the postulate that Electric Vehicles are the solution.

Let's first understand what an EV constitutes!

An electric vehicle works on the simple principle of science: conversion of energy. Electrical energy is converted into mechanical energy. Rather than the engine in fossil fuel cars, EVsusea

motor. The components that constitute the EV are a battery, a charge port, an AC/DC converter, a motor, a Power electronics controller, a thermal regulatory system, transmission wires, packs, and a car body. So important component is the battery.

Batteries

Motors in the electric vehicle draw their power from batteries. Batteries are energy storage systems that are essential for all-electric vehicles whether it is all-electric vehicle type or HEV's and PHEV's. Battery packaged into aluminum case '+' anode that is graphite then coated in copper foil.' – 'cathode is a mix of cobalt, nickel, and manganese which is a metal oxide. The electrolyte is lithium salt dissolved in a solution known as a solvent which is usually ethylene carbonate. The separator between the cathode and anode is made up of polypropylene or polyethylene. The individual battery cells within the module need protection from heat and vibration, so several resins are used to provide mechanical reinforcement to the cells within the module; epoxy, urethane, silicone, acrylic, and polyester. The circuit board of silicon, and wires (copper wire and plastic for insulation). However there are different types of batteries that perform differently in many parameters than each other.

Lithium-ion batteries: These are the most widely used battery. Almost all portable consumer electronics such as cell phones, laptops, and almost every electronic gadget are rechargeable. Li-ion batteries are the most efficient rechargeable batteries in the electrical energy storage system because it has high energy per unit mass relative to other batteries. They also have a high power-to-weight ratio, high energy efficiency, good high-temperature performance, and low self-discharge.

Nickel-Metal Hydride Batteries: These typesof batteries are used routinely in computer and medical equipment and offer reasonable specific energy and specific power capabilities. These have much longer life cycles than lead-acid batteries and are safe and abuse-tolerant. These batteries have been widely used in HEVs. The main challenges with nickel-metal hydride batteries are their high cost, high self-discharge, and heat generation at high temperatures, and the need to control hydrogen loss.

Lead-Acid Batteries: These types of batteries are designed to be high power and are inexpensive, safe, and reliable. However, low specific energy, poor cold-temperature performance, and short calendar and lifecycle impede their use. Advanced high-power lead acid batteries are being developed, but these batteries are only used in commercially available electric drive vehicles for ancillary loads.

Ultracapacitors: Ultracapacitors store energy in a polarised liquid between an electrode and an electrolyte. Energy storage capacity increases as the liquid surface area increases. These can provide vehicles additional power during acceleration and hill climbing and help recover braking energy. They may also be useful as secondary energy storage devices in electric-drive vehicles because they help electrochemical batteries level load power.

Table 1: Comparison of batteries by some basic parameters.

Parameters	Lithium-ion	Nickel-metal	Lead-acid	Ultracapacitors
Low Cost	✓	✗	✓	✗
Energy efficient	✓	✓	✓	✓
Temp. Performance	✓	✗	✗	✓
Low Weight	✓	✓	✓	✓
Life Cycle	✓	✗	✓	✗

Batteries and Emission (resource exploitation)

Each battery cell in a Li-ion battery consists of four components namely cathode, anode, electrolyte, and separator. The characteristics of the battery cell vary depending on the cathode's chemical composition. The common cathode chemistries used in EV batteries include Lithium nickel manganese cobalt oxide (NMC), lithium nickel cobalt aluminum oxide (NCA), and lithium iron phosphate (LFP). The lithium-ion battery is another critical aspect of EV production and maintenance that needs to be addressed about climate change. Production of lithium batteries requires extensive mining of its ores along with other elements like nickel and cobalt. There are four dominant lithium industry countries in the world which are Argentina, Chile, Australia, and China combined account for 92% of the globe's production. Chile has 21.5%, China has 9.7%,

Argentina has 8.3%, and Australia has 52.9% share in the production. West Australia has the world's largest hard rock lithium mine. Spodumene is a mineral that contains large concentrations of lithium. Chile, Argentina and Bolivia. Are famously known as Lithium Triangle. Cobalt and nickel are also critical to the most commercially available versions. Worlds 70% cobalt a crucial component to current battery tech comes from the Democratic Republic of the Congo which is the 8th poorest country in the world. Unsafe extraction in cobalt mines resulted in fatal birth defects for children and other health conditions. The extraction and processing of lithium require enormous quantities of water. The environment is likely to destroy or deteriorate thousands of acres of habitat. 36.5% of cobalt extracted is used for the production of batteries (4-30 kg of cobalt). The global cobalt industry is estimated to be worth 13.63$ billion by 2027. Cobalt has tripled in the last decade while demand is expected to double by 2035. At such a rate, it alarms great environmental concern. If we look at the economic aspect, across 2021 seaborne lithium prices rose from around 8000 per metric ton to over 30,000$, a 400% rise in mere 12 months. Cobalt prices doubled across 2021 and nickel rose to the highest price in a decade from 17,500% to 21,500$. And demand for cobalt to increase 585% by 2050. Just generating one battery can have a carbon debt rate ranging from 10,000 tons to 40,000 tons of CO2. So, there is no such as "ethical cobalt" or "green lithium". According to Choudhary (2021), "the total emissions per mile for battery-powered cars are lower than comparable cars with internal combustion engine". At the same time, rechargeable lithium-ion batteries remain the biggest emitter since several processes are involved in their creation, including lithium and cobalt mining, production at gigafactories, as well as transportation. In this regard, it takes less to produce a petrol-fuelled car. Again, he states that "between 30% to 40 % extra in production emissions are attributed mostly to EV battery manufacturing which highlights the importance of the problem".

The power source is an essential aspect of EV technology to discuss. How the energy is generated decides whether EV is an eco-friendly notion or not. India is coal coal-dependent nation for energy production. Fossil fuels are still burnt in enormous amountsto generate electricity. Encouraging and pushing society to use EVs in a much quicker manner leads to the

generation and consumption of power, and it has to be fulfilled by burning fossil fuels which indirectly causesenvironmental damage.

Conclusion

It is a well-known fact that fossil fuels largely contribute to the climate crisis, which encourages the government to phase out internal combustion engines and provide accessible EVs for the public. Purchase by consumers is not at a tipping point, but that path is almost certain. UK, Iceland, Belgium, Netherlands, Germany, Denmark, Norway, Sweden, Israel, Singapore, and South Korea have committed to ban the sale of internal combustion engines within a decade. The US and China have the largest EV markets and production. In 2012, the EV market was just 0.17% about 30,000 EVs sold worldwide. Now 6.6 million of EV sold which is 8.5% of globally in 2021.Now EVs are almost certainly a disruptive technology- they are almost certainly a technology that will, with time, become dominant over their predecessors. But Enormous number of pollutants are released during lithium mining. For every ton of extracted lithium, between 5 to 15 tonnes of carbon is created. Medium-sizedEVscreate around 76-83 grams of CO2 for every km driven for their lifetime. A similar-sized car with a conventional engine emits 250gm CO2 per km. Right now, lifecycle emissions of electric cars in Europe are 66-69% lower than gas-powered cars. It is estimated that up to 60% more carbon is in the manufacturing of EVs than petrol or diesel vehicles. If you drive an EV in Norway, it contributes less CO2 as power comes from near zero emission hydroelectricity but drivingthe same car in China or India CO2 contribution is higher as power comes from coal-fired power stations. Which is equivalent to using two-thirds of a tank of petrol. So EVs are only as green as the power grid they draw from. Overall, while EVs continue to contribute to CO2 emission in production, the total Green House Gas emissions are expected to decrease in the long term.

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