International Journal of Engineering and Management Research e-ISSN: 2250-0758 | p-ISSN: 2394-6962
Volume-12, Issue-4 (August 2022)
www.ijemr.net https://doi.org/10.31033/ijemr.12.4.25

A Conceptual Study of Electric Vehicle Market in India

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ABSTRACT

Research into electric vehicles (ev) as a potential means of reducing the greenhouse effect is extensive. Thanks to improvements in power electrics, energy storage, and support, the plug-in hybrid electric vehicle (phev) offers competitive driving range and fuel economy when compared to vehicles powered by internal combustion engines (icev).the various sorts of evs' operational procedures will be detailed in this review study. We'll also talk about battery and supercapacitor technology as potential ways to boost phevs' energy capacity.

***Keywords*--** EV, Battery, Charger, Fossil Fuel

I. INTRODUCTION

Despite the fact that electric vehicles (EVs) have been around for a while, over the past ten years the level of innovation and importance in the space has accelerated. The performance difference between EVs and their internal combustion engine (ICE) competitors is no longer as great as it previously was. In reality, EVs perform far better than ICE cars in terms of a number of transport policy objectives, such as improved power security, less dependency on crude oil, improved air quality, and lower greenhouse gas emissions. As a result, EVs are quickly becoming the preferred clean technology for transportation in the future. While developments, notably in battery and charging technology, are projected to further drive down costs, the economics of EVs have also greatly improved. Despite the compelling rationale for adoption, EV performance to date has been hindered, among other things, by low customer appetite and infrastructure impediments. Customers' expectations for several EVs that have been released in India have not been met because to issues with upfront pricing, range, speed, battery life, and battery technology. The effects of the coronavirus outbreak and subsequent lockdowns have also had a severe impact on the automobile industry, further preventing the transition to EVs as a result of the delays in a number of projects. Even though EVs represent less than 1% of the market as a whole, there is still a lot of room for advancement. Additionally, India is one of the major nations in the world for EV unit sales, so any association in EV quantities is expected to have a significant impact on the adoption of EVs worldwide. Despite the fact that India's automotive sector had been experiencing a slump before the COVID-19 outbreak hit, it is still one of the world's largest automobile markets in terms of sales volume. In FY20, India recorded domestic car sales of 21.5 million, down from 26.2 million in FY19.

Indian politicians have actively pushed for the deployment of EVs in recent years. NITI Aayog, a government think organisation, claims that the FAME II and other initiatives towards quicker adoption and production of hybrid and electric vehicles promoting, and within 2030, sales distribution of EVs is anticipated to expand to 30% for private automobiles, 70% for commercial cars, 40% for buses, and 80% for two- and three-wheelers.

Popular contemporary manufacturers and newly committed companies have worked very hard in recent years to transform the conventional vehicle into an electric vehicle that results in a dependable and green solution. In terms of market share, EV demand is increasing. In the United States, Europe, and Asia, it begins to supplant conventional vehicles. Although more work must be done to expand the range of autonomy and the variety of applications, EVs are a fantastic option for every end user thanks to changed perceptions and a competitive price (Entry range).The following are the key benefits of using electric vehicles over those with gasoline engines.

1. There is no pollution produced by them.
2. They make less noise.
3. They assist us in conserving fossil resources.
4. They start with a lot of torque.
5. Without going to a charging station, they can be charged at home.

The aforementioned advantages have made electric automobiles popular on the market, and their number is growing everyday.

II. THE OPERATION OF ELECTRIC VEHICLES

Utilizing electric vehicles is primarily done to conserve fossil fuels. Batteries, capacitors, flywheels, and other energy sources are employed to achieve this, and fuel cells can also be used to produce energy. In the beginning of the era, only "pure" electric cars were in use; these cars rely solely on batteries for power and require frequent recharging. Hybrid electric vehicles are the most recent advancement in electric vehicles and employ a combination of energy sources. They are superior to pure electric vehicles because the supporting secondary device can handle a large number of vehicles, a battery, and temporary operations.

- As an illustration, consider how a hybrid system battery is supported by a super capacitor under high and transient loads. This makes the system competent and preserves the battery's health.
- Lead-acid batteries are the standard for electric vehicles, but novel battery types including sodium-sulfur, zinc-chlorine, and nickel metal hydride are starting to become more common.
- The motor of an electric vehicle transfers the electrical energy from the battery into kinetic energy.
- The driver only needs to turn on the power, choose "Forward" or "Reverse" with a different switch, and press the accelerator.
- An electric motor just has one rotating element, as opposed to the internal-combustion engine of a traditional car, which must transform the linear motion of pistons and rods into rotational motion at the wheels.
- Just like a gasoline-powered vehicle, an electric vehicle transmits motion from the engine to the wheels using a series of gears, shafts, and joints. This system is known as the power train. Most electric cars lack multispeed gearboxes and clutches.
- To move backward, the motor's current flow is reversed, changing its spin and causing the power train to turn the wheels in the other direction. Regenerative braking is a common feature of electric vehicles and serves as a battery charger. The motor begins to function as a generator and supplies electricity to the battery when the vehicle slows down or when the brakes are engaged.
- Regenerative braking is the term for this type of braking, which frequently serves as a battery charger. The vehicle is slowed down by the conversion of kinetic energy to electric energy.
- Traditional braking systems, which use friction to slow the car for quick and emergency stopping, are also present in electric vehicles together with the brake pedal.
- Kinetic energy is converted into heat via the friction braking mechanism. In gasoline-powered automobiles, there is a greater energy waste.
- The environment around the object generates heat. The engineers came up with a different approach to recover the heat, such as heating the passenger area.

III. ELECTRIC VEHICLE TYPES

It can be challenging to choose a new car at the best of times, but it becomes even more challenging when you're attempting to understand all of the various hybrid car models available. Below is an explanation of the many types of automobiles. 2.1 Plug-in Hybrid Electric Vehicles (PHEV): These vehicles also combine an internal combustion engine with an electric motor. Plug-in electric motors, on the other hand, are recharged by connecting the car to a unique power source. These automobiles are capable of running on gasoline or electricity. When the motor stops producing power when they are used for extended distances, the driver can switch it to gasoline powered. When operated in electric mode, these cars typically travel 150 to 200 kilometres. There are no tailpipe emissions while the automobile is used in electric power mode, however there are typical emissions when the car is operated in conventional fuel mode. Such a car is great for city driving.

3.1 Battery Electric Vehicles (BEV)

A battery is attached to an electric motor, which provides the vehicle's power. These cars' internal energy source is a battery. These vehicles benefit from the battery's zero-emission operation. They utilise a technology known as "energy recovery technology." When braking, when the vehicle is moving down a slope, and when it is moving freely with respect to gravity, this electric motor functions as both a momentum source and a generator. This improves a vehicle's efficiency. Due to the strong torque of the electric motor that is communicated to the wheels and the smoother acceleration compared to vehicles with internal combustion engines (ICE - Internal Combustion Engines), BEVs prove to be an excellent choice in traffic.

While the electric motor is running, BEVs make no noise and emit no pollutants. These characteristics make BEVs the perfect cars for use in cities and/or other urban settings. In addition to the aforementioned advantages, employing BEVs has certain drawbacks as well:

1. Exorbitant production expenses

2. A smaller size overall (compared to equipped with internal combustion engines).
3. Top speed and restricted autonomy.
4. Prolonged recharge times or the requirement for dedicated charging stations
5. Road accidents may occur if electric motor noise is absent (persons with hearing disabilities, pedestrians, cyclists, etc.).

According to how electric power is transmitted, there are two different categories of battery electric vehicles:

1. The electric motor takes the place of the internal combustion engine. Through a transmission, the electric motor's power is delivered to the wheels (gearbox).
2. The advantage of using a central electric motor design is that it allows for adoption of the same design as currently on the market autos. There is an electric motor installed in each wheel (hub motor). Depending on the load applied to the vehicle and the traffic circumstances, employing the gearbox also improves the efficiency of the use of the power supplied by the electric motor. However, it should be noted that utilizing a device

3.2 Fuel Cell Electric Vehicles (FCEV)

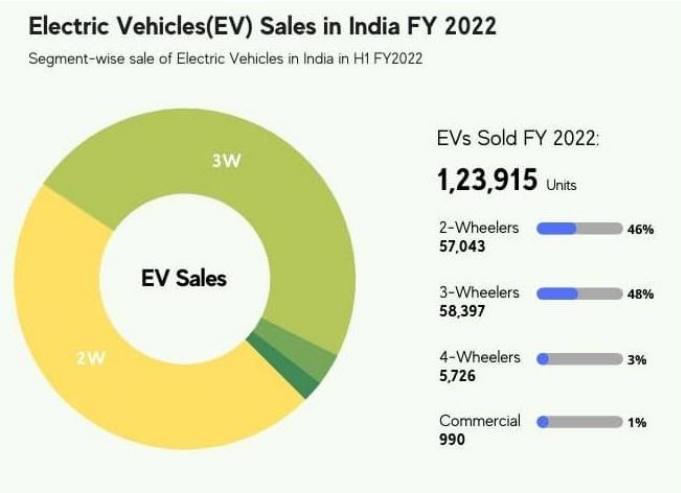
An electric motor inside an FHEV is fueled by a chemical reaction that occurs when oxygen and hydrogen are combined. The fuel cell sucks in oxygen from the surrounding area, which reacts with the hydrogen that has been stored. The motor is powered by electricity, which is produced, and the vehicle moves. Although water is created as a waste byproduct during this process, there are no hazardous emissions from the vehicle. While the procedure of filling the cell does take a few minutes longer than it does to top-up a petrol tank, the hydrogen cell must be topped-up in a manner similar to that of standard fuel vehicles. The emissions from producing hydrogen for these fuel cells are comparable.

3.3 Hybrid Automobile:

An HEV is a hybrid electric vehicle. It is a vehicle that draws electricity from two or more sources. The two sources are mechanical power from an internal combustion engine or any other auxiliary source, and electrical power from batteries. With the power and range of fossil fuel cars, this combination offers very low emissions of vehicles. Additionally, they provide up to 30 more miles per gallon, perform on par with or better than gasoline-powered vehicles of similar size, and never need to be plugged in to recharge. A hybrid road vehicle is one that uses two or more types or sorts of energy storage, sources, or converters, at least one of which must be a store or converter, to provide propulsion energy during specific operating tasks.

IV. INDIA'S ELECTRIC VEHICLE STATISTICS

In India, the market for electric vehicles grew extraordinarily after the Covid-19 epidemic scenario. Data from the Centre for Energy Finance at the Council on Energy, Environment and Water at the Centre for Energy Finance (CEEW-CEF) shows that in the first half of FY 2022, to 1.18 lakh units, electric car sales increased by three times.



Source: CEEW-CEF (www.ecogears.in)

CEEW-CEF statistics show that 1,21,815 electric vehicles were sold in total between FY 2021 and FY 2022. There were 57,043 2-wheelers, 58,396 3-wheelers, 4,726 4-wheelers, and 910 freight and heavy-duty electric vehicles.

e-ISSN: 2250-0758 | p-ISSN: 2394-6962
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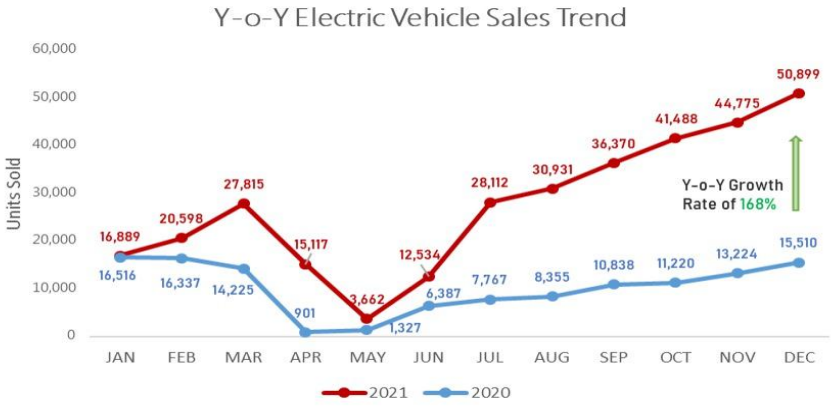
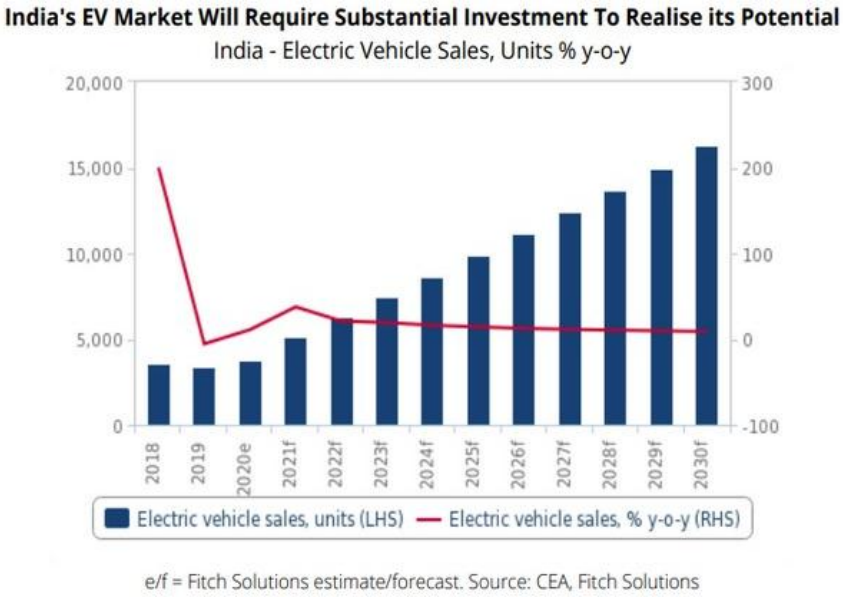
Manufacturers' stated increases in electric car sales have boosted the price of electric vehicle equities listed on the stock market. The overall sales of electric vehicles in India have been greatly impacted by the supporting to lower the upfront cost of purchasing an electric vehicle, national regulations and state-specific subsidies are in place. History is being created with India's largest shift in mobility patterns.

Customer awareness, decreased reliance due to inconsistent manufacturing, rising fuel prices, and the development of a widespread charging infrastructure, there is a dependence on battery imports are the main factors influencing the sales of electric vehicles in India.



Source: Vahan Website & Telangana Regional Transport Data Portal

The primary technologies that enable electricity in India are also included in the paper. Lead-acid batteries, which currently predominate due to their low cost but are very toxic and not disposed of cleanly, are generally being phased out. Due to the high summer temperatures of 45 degrees C and the custom of leaving parked cars in the scorching sun while charging or dwelling at home or work, countries like India have difficulties with the shift to Li-ion batteries. Market leaders are collaborating with battery manufacturers to develop chemistries that will help address this problem. The research also discusses electric grip motor technology. Here, available options range greatly from specialised, cutting-edge permanent magnet synchronous motors to off-the-shelf brushless DC alternatives produced and imported from China.



Source: the print.in/ani-press-releases/fy 21-23

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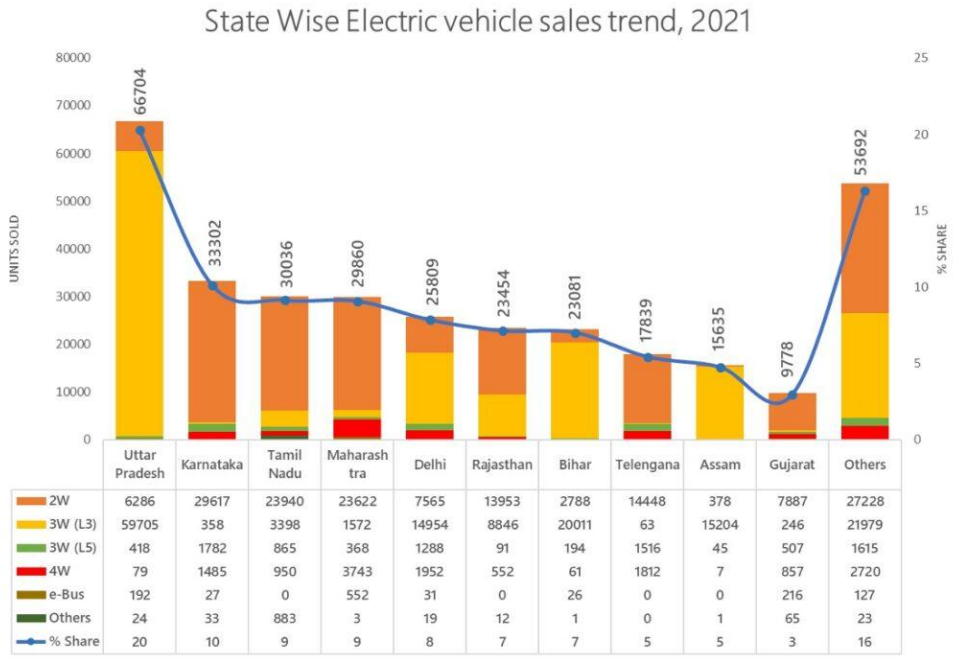
It was noted that India's recently announced electric vehicle (EV) incentives and high fuel prices will support a greater uptake of EVs over the 2020–2023 period, resulting in an average annual growth rate of 26%. However, it was noted that the economic effects of the COVID–19 pandemic and the scarcity of domestically produced EVs will prove to be difficult obstacles to overcome. As more nations seek to sustain EV uptake, reduce emissions, and draw investment in EV-related industries, the EV market will continue to expand quickly across the whole Asia region.

In contrast to the expected rise of just 4.8% in 2020, Fitch predicted that EV sales in Asia will increase by 78.1% in 2021.



	Uttar Pradesh	Karnataka	Tamil Nadu	Maharashtra	Delhi	Rajasthan	Bihar	Telengana	Assam	Gujarat	Others
2W	6286	29617	23940	23622	7565	13953	2788	14448	378	7887	27228
3W (L3)	59705	358	3398	1572	14954	8846	20011	63	15204	246	21979
3W (L5)	418	1782	865	368	1288	91	194	1516	45	507	1615
4W	79	1485	950	3743	1952	552	61	1812	7	857	2720
e-Bus	192	27	0	552	31	0	26	0	0	216	127
Others	24	33	883	3	19	12	1	0	1	65	23
% Share	20	10	9	9	8	7	7	5	5	3	16

Source: Vahan Website & Telangana Regional Transport Data Portal

V. STATE EV GUIDELINES

Eight Indian States have developed the following policies to hasten the adoption of electric vehicles:

• **Karnataka:** The first state in the nation to adopt an electric vehicle policy was Karnataka. It is anticipated that the Karnataka Electric & Energy Storage Policy, 2017, which is in effect for five years, will provide the essential impetus for the state's electric mobility sector and draw investments. Bengaluru will become the Indian capital of electrical vehicles, according to the Karnataka government.

• **Delhi:** Despite its unfavourable reputation as one of the world's most polluted cities, New Delhi is making a lot of effort to improve its environment. With the intention of promoting the usage of battery electric vehicles more quickly, the Delhi Government introduced the EV Policy in 2020.

• **Maharashtra:** The government published its EV guidelines in 2019 with the plan of making the state one of the most popular Electric Vehicles venture forecasts for foreign shareholders. This goal was achieved through promotional strategies and the construction of an aggressive and stable investment atmosphere.

• **Uttar Pradesh:** One of the ten cities selected for the numerous Electric municipal transportation Pilot Project below the FAME scheme in the capital city of UP, Lucknow. In light of this, the Uttar Pradesh Electric Vehicles Manufacturing and Mobility Policy, 2019, was released by the state government.

• **Telangana:** In order to present a model of international standards for EV adoption diagonal segments, supported by world-class facilities and ecosystem, the State of Telangana released its draught EV Policy in 2018.

• **Andhra Pradesh:** The ambitious goal of the government of Andhra Pradesh is to put 10 lakh electric vehicles on the path in the coming 5yrs. This goal determines and assisted through financial encouragement, and the state hopes to turn out to be individual in the primary core meant for this market within nation. In 2018, present authority introduced its electric mobility policy.

• **Kerala:** Kerala also released an EV Policy in 2018 with the goal of reducing the number of fossil fuel-powered cars by introducing E-Transportation for the people

commutation and Electric enabled Rikshaws. The goal may be in favor of all motor vehicles to be fully electrified by 2030.

• **Uttarakhand:** In 2018, the Himalayan State of Uttarakhand released its EV Policy. The State intends to foster a supportive environment for businesses and lessen vehicle pollution. Additionally, it aims to generate employment in the State.

VI. INDIA'S DEMAND FOR EVS IS INCREASING

According to the FAME India website, as of May 2020, 2,80,988 EVs had been sold throughout India. Following the announcement of the FAME-2 policy in March 2019, a total of 19,355 automobiles have been sold to date. According to Berkeley Labs' "Techno-Economic Assessment of Depth Electrification of Passenger Vehicles in India," the sale of EVs would reach 30 million 2 wheelers per year and 10 million 4 wheelers per year by 2030 if all vehicles sold in India by that time were EVs, which is in line with the Government of India's vision. The price gap between a BEV and an equivalent conventional sub-compact automobile is anticipated to decrease by 65% between now and 2025. The incremental manufacturing cost of BEV will come down significantly. Considering the petrol price and electricity tariff to be stable at 2015 level, annual cost in terms of capital cost + running cost of EVs would be significantly lower than that of ICEs. It is estimated that the annual energy demand by 2030 in the country shall be ~2,522 TWh with 402 GW peak load under Business as Usual scenario (by extrapolating National Electricity Plan (NEP) up to 2027). The impact of additional energy requirement due to BEVs is estimated at 82 TWh/year, which is ~3.25% of the total electricity demand. The increase in peak demand from EV charging is (23 GW) or (5.6%) of the anticipated peak demand, and the demand improvement of other loads will also be higher at the same time.

VII. CONCLUSION

Due to their extremely low to zero carbon emissions, low noise, great efficiency, and flexibility in grid operation and integration, electric vehicles (EVs) are a viable technology for establishing a sustainable transportation sector in the future. In contrast, sales of EVs are still languishing in other emerging and developing nations, where the few models that are still on the market are still out of reach for the mass market. However, EV sales doubled in a number of places in 2021, including India. If supportive investments and legislation are put in place, this might pave the path for a rapid global penetration by 2030.

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