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An Analytical Progress by Unleashing the Potential of Electric Cars in India

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Abstract
As a sustainable transportation option, electric Vehicles (EVs) are swiftly acquiring popularity across the world. EVs are seen as the future of the automobile industry because of their zero carbon emissions and environmentally beneficial characteristics. The goal of this paper is to discuss the need for improvements in the EV industry of India, with a particular emphasis on the rising EV sales in India. The EV's commitment to environmental sustainability is one of the main benefits. EVs are essential in reducing air pollution and halting climate change since they emit no carbon during operation. As it improves energy security and lessens reliance on non-renewable resources, decreasing reliance on fossil fuels is another important factor in the shift to electric vehicles. The necessity for more developments in the EV market—including technology innovation, infrastructural growth, and encouraging governmental policies—is highlighted in this article. The widespread use of EVs may be hastened by addressing these issues, creating a cleaner and more sustainable transportation industry. The article discusses the astonishing development of the Indian EV market with a focus on the Indian environment. The Indian government has developed many measures and incentives to encourage the use of EVs in light of the increased focus on electric transportation. The techniques used to support the rising sales of EVs in India are examined in this research. These efforts include subsidies, the construction of charging infrastructure, and awareness campaigns. This study also emphasizes the need of developing the EV industry as a way to lessen reliance on fossil fuels and create a sustainable transportation system. This study seeks to shed light on the developments in the Indian EV sector as part of the country's continuous shift to electric transportation.
Keywords: - Electric Vehicles (EVs), automobile industry, transportation

I. Introduction: -

India's demand for electric cars (EVs) is becoming more and more obvious as the nation works to combat climate change and lessen its reliance on fossil fuels. Since road cars account for a sizable amount of pollutants, it is essential to reduce automotive emissions by moving away from vehicles with combustion engines. Electric vehicles have gained popularity as a potential solution, however they are insufficient on their own to solve the environmental issues brought on by transportation. It would be logistically and politically difficult to replace or refit all existing cars quickly with electric ones. Additionally, despite rising adoption rates, sales of new automobiles still only account for a small portion of electric vehicles.With an increase in EV registrations and challenging goals set by the government, India has witnessed a considerable increase in the adoption of EVs. By 2030, the Indian government wants to electrify 35% of its vehicle fleet, and to that end, it has put in place a number of incentives and laws to encourage the development of the EV market. Subsidies, the creation of infrastructure for charging, and awareness campaigns are a few of these initiatives.[1]However, it is crucial to understand that the switch to EVs should be accompanied by more extensive reforms, such as a decarburization of the power sector and a rise in the integration of renewable energy sources. The environmental advantages of EVs may be further improved with the use of intelligent charging systems and a concentration on renewable energy sources [2]. With sales of electric cars expected to increase in 2023 and major proportions of two-wheelers and three-wheelers becoming electric, the

EV industry in India has experienced extraordinary development over very short span of time. The majority of policy assistance has gone towards lowering the cost of EV purchases, but it is still important to move towards price parity with conventional cars.Due to India's goal to lowering emissions, combating climate change, and developing a sustainable transportation system, the country's demand for EVs is rising. The government's initiatives, as well as developments in technology and infrastructure, are promoting the use of EVs. To fully realize the potential of EVs in India's transportation industry, a complete strategy including supporting legislation and the integration of renewable energy is essential. Vehicles.The Year 2023 has been great for the sales of EV in India as for the first time in the month of May 2023, the sales crossed 150,000 units. The month of May has been the eight consecutive month with sales over 100,000. The two wheelers has swift increase in the number of sales. The Year on Year growth in the field of EVs in India is clear indication that the Evs are going to the next big thing in India.With modern Evs using special motors to reduce the consumption of energy.More and more focus is being taken on the technologies development of India.

ELECTRIC VEHICLE RETAIL SALES IN INDIA FOR FIRST 5 MONTHS OF CY2023					
Sub-segments	**January '23**	**February '23**	**March '23**	**April '23**	**May '23**
Two-wheelers	64,663	66,053	86,252	66,725	1,04,829
Three-wheelers	34,315	36,011	45,236	38,012	44,609
Passenger vehicles	3,433	4,752	8,805	5,982	7,443
Buses	97	98	87	84	274
Light goods vehicles	66	114	83	142	160
Heavy goods vehicles	0	0	183	46	0
Others	1	81	23	8	23
Total	**1,02,575**	**1,07,109**	**1,40,669**	**1,10,999**	**1,57,338**
Data: Vahan					

Figure 1. EV Sales in 2023

EV SALES IN INDIA HIT RECORD 157,000 UNITS IN MAY 2023			
Sub-segments	**May '23**	**May '22**	**YoY Growth**
Two-wheelers	1,04,829	42,415	147.15%
Three-wheelers	44,609	24,099	85.10%
Passenger vehicles	7,443	2,961	151.36%
Buses	274	165	66%
Light goods vehicles	160	44	263%
Heavy goods vehicles	0	217	
Others	23		
Total	**1,57,338**	**69,901**	**125%**
Data: Vahan			

Fig 2. EV sales in May 2023

Figure 1. Showsthe data of sales in first six months of 2023.Figure shows 8the EV sales in Indiahitting a record mark. Figure 2 shows the EV sales in India hitting a record mark.

II. Literature Review

The majority of the literature search was devoted to subjects concerning electric and hybrid vehicles. The analysis of research studies and publications demonstrated thefundamental principles and favorable outcomes anticipated, in support of society and future demands for the conservation of fossil fuels and an awareness of environmental contamination.

The car industry is progressing as a result of the development of new technology. Alternatives to internal combustion engines include electric automobiles. Demand for electric vehicles is rising globally due to their lower CO2 emissions. The Indian government also intends to boost the production of electric vehicles in the automotive sector. The market for electric cars in India is affected by economic, social, technological, and environmental issues that present both possibilities and problems. [3]

There are three categories of vehicles in the Indian auto market: two-wheelers, commercial passenger automobiles, and others. Passenger cars and two-wheelers are the most popular vehicles, and this market segment will rule the electric vehicle industry. By 2025, it is anticipated that the Indian

passenger car segment would control three-fourths of the global market for electric vehicles. The automobile business is changing as a result of the development of transportation using electric vehicles and changes in customer preferences and environmental sustainability.[4] A linked vehicle with enhanced intelligence for driving tasks is an automobile. Automakers are being pushed to reconsider their plans and strategies as a result of shifting customer preferences and technology disruptions that are changing the mobility landscape. Despite many obstacles and constraints, the number of electric vehicles in India is steadily rising because to FAME India's electric vehicle incentives.Initiated by the federal government to meet the NEMMP 2020 target and a manufacturing goal of over 7 million EVs by that year. [5] Electric cars have low operating expenses for maintenance. 3. As 80% of the crude oil needed is imported, the price of crude oil is rising. Although the EV market in India is still in its infancy and the opportunities there currently appear to outweigh the challenges, if the government takes the appropriate action by supporting EV dynamics in India at various levels, it is anticipated that this will change in the future when there are many more opportunities [6].The government must commit, but awareness-raising among Indian citizens is also essential. To start the market sales, the financial restraints should also be resolved appropriately.[7]

III. The Electrification of Vehicles: A Changing Environment

The growth of electric vehicles hs been tremendous over Over the past few year as the technology and trends in vehicle electrification have accelerated. The current stats indicates that these stats will reach a record point somewhere in the early 2030s, when it is anticipated that 30% of all sales vehicles will be electric. This will happen as a result of several convergent causes, some of them have been elaborated in this research. According to the survey of Mckinseya global consulting firm, electric vehicles market was once uncertain however now the market is turning upside right. The growth of Electric Vehicle will increase by sixfold. The annual sales of electric vehicles has increased from 6.5 to 40 million and the stats are dynamic. Most of the researchers are stating that the future of automotive industry is electric.

Due to awareness of environmental initiatives common man now knows the pros and cons of healthy environment and pollution thus this campaign will help electric cars to account for at least 30% of all new vehicle sales, which would treble India's current renewable energy capacity.[8] . The compound annual growth rate (CAGR) for the Indian EV industry is predicted to be 49 percent between 2022 and 2030 3. New Delhi intends to increase the percentage of electric vehicles (EVs) from the current 1% to 30% by 2030 and has implemented a number of initiatives to achieve this goal, including tax benefits for customers 6. EVs presently account for just 1% of the 3 million automobiles sold annually. [9]

IV. Technology advancements and breakthroughs driving the growth of EVs in India

EVs are now an affordable choice for many drivers worldwide and also in India because of the developments in battery technology, an increasing network of charging infrastructure, and rising customer demand. The growth of EV's is direcly linked with EVs Because they are fueled by energy that is stored in batteries and use electric motors rather than petrol to spin the wheels, these cars are changing the way we think about driving. as they are powered by energy that is kept in batteries, concerning driving and more importantly donot have adverse effect on environment [10]. Moreover the infrastructure has improved. The private bodies are also investing on the growth of infrastructure for charging vehicles. The development of this infrastructure is crucial to addressing range anxiety and offering EV customer's practical charging alternatives. Integration of EV charging with the smart grid is another area of technological development in India.[11] Smart charging innovations help to manage the grid's load and facilitate efficient power consumption. This combination enables demand response, grid stability, and optimal charging schedules. Connected

and autonomous features: EVs are gradually embracing connected and autonomous features, which enhance the whole driving experience. Some of these features include the integration of smart devices, connectivity for remote monitoring and control, and advanced driver aid systems. The combination of EVs with cutting-edge technology like artificial intelligence and the Internet of Things (IoT) is expected to further alter the EV industry. Another element contributing to the increase of EVs in India is the usage of data analytics. Data-driven insights help to estimate maintenance requirements, improve the infrastructure for charging, and increase operational efficiency as a whole. Through analysis of EV usage and charging trends, stakeholders can enhance the EV ecosystem and adopt well-informed actions.

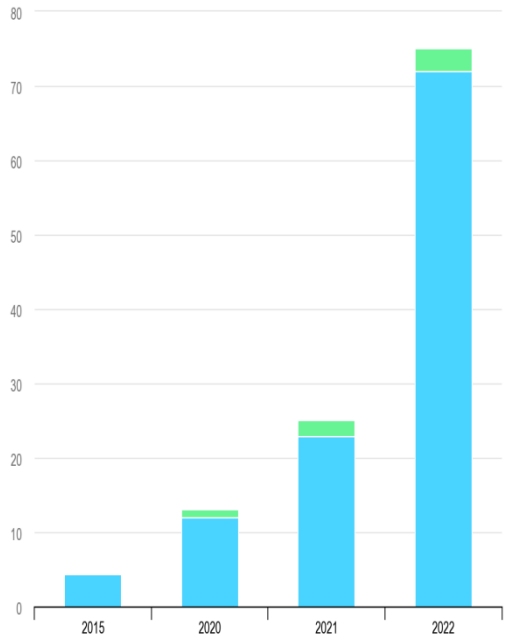

Figure 3:- Evolution of EV stock in India

The increasing integration of connected and autonomous technologies into EVs enhances the entire driving experience. Some of these features include the integration of smart devices, connectivity for remote monitoring and control, and advanced driver aid systems. The combination of EVs with cutting-edge technology like artificial intelligence and the Internet of Things (IoT) is expected to further alter the EV industry. The vehicle to grid technology will be also enhancing the features of Electric vehicles. It aids EVs to feed the excessive energy back to the grid for the optimal utilization of energy.

V. The Riseof electric vehicle market in India

The Electric vehicle (EV) market is growing in India for a number of reasons, including positive government policy, rising consumer demand, and technological breakthroughs. India has high development goals for the EV market because of the country's massive oil imports, growing pollution levels, and the need to battle climate change[12].EVs provide smart cities a significant opportunity to utilize greener fuel technologies for urban mobility. India's market for electric cars is anticipated to grow at a CAGR of 77% in terms of value between 2017 and 2025, according to a Persistence Market Research analysis. Forecast by Type of Vehicle India's electric vehicle market is projected to grow at a 37% CAGR between FY 2018 and FY 2023 as a result of rising government initiatives, growing consumer interest, worries about the negative effects of air pollution, and significant investments made by various OEMs in the
development of more accessible premium electric vehicles. The market for electric cars (EVs) is expanding quickly on a global scale. The EV market has now experienced tremendous growth in India as well. After the Ministry of Heavy Industry and Public. Enterprises implemented the FAME (Faster Adoption and Manufacture of Hybrid and Electric Vehicles) initiative in 2015, the market is expanding further. Sales of all electric vehicles reached 365,920 units in 2018 and are projected to increase by 36% CAGR through 2026. In India, the market for EV batteries is anticipated to reach US$ 520 million in 2018 and increase at a CAGR of 30% through 2026. The total MWh addition in 2018 was 4.75 GWh, and by 2026, it is anticipated to increase to 28.0 GWh. India is one of the largest markets for EVs in Asia, behind China and ahead of Japan. If India achieves its true potential of 50% electrification, every 10th EV globally sold could be manufactured in India making it the global EV powerhouse. EV manufacturers in

India have announced a significant increase in production, the big corporations are choosing EVs to deliver goods and services, the consumers are slowly adopting and preferring electric and hybrid variants evidenced by the rise in demand.India has the greatest untapped EV market in the world, particularly for two-wheelers. The penetration of electric vehicles has greatly risen over the past few years as a result of several automakers releasing these vehicles at a quick rate. According to a recent estimate, the market for electric cars (EVs) is predicted to be worth at least 475 billion by 2025. Up to 15% of two-wheelers are expected to be electrified by 2025, up from the present 1% penetration rate.[13] A survey on electric vehicles suggest that 75% of the people want to buy electric vehicles. Electric Vehicle have the potential to support renewable energy under the government policies. Electric vehicle adoption in India increased significantly in 2022, with sales of the cars tripling to 48 000 from 12 000 in 2021. The market share of two-wheelers increased to 7%, while the number of new electric three-wheelers sold, at 450 000, increased to 55% from 350 000 in China. In Tamil Nadu, one of the biggest two- and three-wheeler factories is being constructed. Figure 3 shows the Evolution of EV stock in India with a stiff increase from 2015 onwards. [14]

The Adoption and Manufacturing of Hybrid and EV (FAME) II initiative, funded by the Indian government, intends to increase global capacity for battery and EV manufacturing while reducing the consumption of primary oil and urban pollution. 2015 saw the launch of the program's first phase, which had a budget of INR 5.3 billion (USD 65 million1). The second phase of FAME commenced in April 2019 with finance increasing to INR 100 billion (USD 1.2 billion), with more than 85% of the cash going towards EV purchasing incentives. In addition, as part of the scale up, a component for the deployment of charging infrastructure was added, accounting for 10% of the expenditure. In 2021, the plan was extended to 2024.[15]

VI. Conclusion

With the development and advancements in technology, the market for electric cars is continually pushing the growth of electric vehicles in India. Various measures are being done to encourage the usage of EVs. Additionally, as the general public is more environmentally conscious today, everyone is interested in purchasing electric automobiles. Over the past several years, the development of stocks in electric cars has multiplied. The paper discussed. The growth of EVs is predicted to reach 35%, making the future of EVs in India not only promising but also expected to grow even more promising. The switch to EVs is projected to result in new employment being created in the setup, maintenance, and manufacture of EVs and charging infrastructure, which can boost the country's economy and promote sustainable growth.

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