



Self-Reliance in the Electric Vehicle Ecosystem in India: The Path to Aatmanirbhartha

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Abstract: Environmental pollution is currently a paramount global concern. In recent years, governments worldwide have shifted their focus towards developing the electric vehicle (EV) ecosystem in emerging economies to mitigate harm to the natural environment. This paper centers on examining India's EV ecosystem. The research reveals that while EV sales are experiencing triple-digit growth, the establishment of a robust support infrastructure lags behind. Notably, the ratio of public charging stations to EVs sold in India is significantly inadequate. To emerge as a leader in the EV industry, India must invest in cutting-edge technologies such as lithium cell manufacturing and fast charging infrastructure. Additionally, prioritizing research and development (R&D) is imperative for achieving self-reliance Aatmanirbhar in the EV ecosystem.

Keywords: Electric Vehicle, Technology, Self-Reliance, Lithium Cell

I. INTRODUCTION

Environmental pollution currently stands as the biggest global concern. Toxic emission from internal combustion engines is the leading contributor to the air pollution. Coupled with other greenhouse gases (GHGs) emitted from human activities, increasing concentrations of CO₂ are driving global warming. To combat the harmful effects of fossil fuel emissions and tackle environmental concerns (ECs), there's a concerted global push towards aggressive promotion of electric vehicles (EVs). Powered by electric motors, EVs rely on rechargeable batteries or other portable energy storage devices to maintain power supply. These vehicles demonstrate high energy efficiency, resulting in reduced greenhouse gas (GHG) emissions and lower levels of noise pollution.

A. Types of Electric Vehicle

i. PHEV

Plug-in Hybrid Electric Vehicles (PHEVs) feature a small engine alongside larger batteries. These vehicles recharge their batteries either through regenerative braking, which captures energy during braking, or by connecting to an

external electric charging point.

ii. BEV

Battery Electric Vehicles (BEVs) lack an internal combustion engine and rely solely on electric motors for propulsion, with batteries serving as the primary energy storage device. Charging for BEVs is exclusively reliant on external power points. These vehicles are also referred to as plug-in vehicles, EVs, or Battery Electric Vehicles (BEVs). The below table shows the electric vehicle sales all over the world from 2011 to 2022.

Table 1: Sales of Electric Cars Around the World 2011-2022

Year	BEV	PHEV
2011	39,000	0
2012	58,000	60,000
2013	1,10,000	91,000
2014	2,00,000	1,30,000
2015	3,30,000	2,20,000
2016	4,60,000	2,90,000
2017	7,60,000	4,20,000
2018	14,00,000	6,50,000
2019	15,00,000	5,80,000
2020	20,00,000	9,70,000
2021	46,00,000	19,00,000
2022	73,00,000	29,00,000

Source: Global EV Data Explorer

Current electric vehicle (EV) battery technology exhibits limitations in both materials and energy density, resulting in heavier vehicles with shorter ranges compared to internal combustion engine vehicles (ICEVs). Additionally, the cost of batteries contributes to the relative expense of EVs for consumers, notwithstanding government incentives, and their production is contingent upon the availability of sometimes-scarce resources. These factors collectively restrict the widespread adoption of battery-electric technologies, particularly in the realm of heavy-duty vehicles. In India, the necessity of transforming to electric mobility was recognised amidst the manifold problems created by fossil fuel use: their fast depletion, rising energy costs, impact of motor vehicles on the environment, and concerns over climate change (Aijaz, 2022) [1]. It is estimated that in 2022, India's transport sector will be responsible for about 375 million tonnes of direct CO₂ emissions, which is about 10 percent of the country's total GHG emissions and Road transport contributes more than 90%, followed by aviation and railways (Natarajan, 2022) [3]. In response to alarming environmental problem, and to facilitate greater adoption of EVs by removing barriers Department of Heavy Industry introduced National Mission for Electric Mobility (NMEM) in 2012

II. REVIEW OF LITERATURE

The automobile industry is gearing up for disruption. The fossil fuel price spike and the impact of its emission on the environment have called for a

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change in individual transportation habits. The sector, propelled by internal combustion engines, is gravitating gradually towards electric vehicles. The transportation sector contributes about a quarter of GHG emissions. Automobiles are the primary source of GHG emission world over with China emitting 25.9 per cent, the USA 13.87 per cent followed by India 7.45 per cent (Khurana, Kumar, & Sidhpuria, 2020) [2]. Hence reducing the usage of fossil fuels by the introduction of electrified powertrain technologies such as Hybrid Electric Vehicle (HEV), Battery Electric Vehicle (BEV) and Fuel Cell Electric Vehicle (FCEV) is perceived as a way towards a more sustainable future. With a seemingly more significant shift towards BEV development and roll-out, the research and development of BEV technologies has taken on increasing importance in improving BEV performance and ensuring its competitiveness (Pesyrdis, et al., 2022) [4].

India's global commitment to reducing the emissions intensity of its GDP by 45 percent by 2030, thereby achieving the goal of net-zero by 2070 These targets are included in India's updated Nationally Determined Contributions (NDCs) for the United Nations Framework Convention on Climate Change (UNFCCC) [5]. Through such measures, India aims to enhance its contribution towards global response to threats posed by climate change, as agreed in the 21st session of the Conference of the Parties (COP 21) or the Paris Agreement (Aijaz, 2022). Budget 2022-2023 has provided a big boost to the electric vehicle's ecosystem [6]. Funds are allocated to Faster Adoption and Manufacturing of Electric Vehicles in India (FAME-India) Scheme has increased three-fold in comparison with previous years [7]. The finance minister later NITI Aayog announced that a battery swapping and interoperability standards will be formulated [8]. Additionally special mobility zone for zero-emission vehicles in urban areas and reduced customs duties on minerals required for indigenous battery manufacturing have also been proposed to encourage manufacturing electric vehicles (Natarajan, 2022) [9].

III. NEED AND OBJECTIVE FOR THE STUDY

From the above literature study, it is clear that, to overcome environmental concerns, serious push towards electric vehicles is very much necessary. In this regards government of India also initiated various policies and measures to boost the sales of electric vehicles. So, it is important to study the electric vehicles ecosystem from manufacturing of battery to establishing public charging stations to identify the opportunities and challenges for electric vehicles in India.

IV. RESEARCH METHODOLOGY

For the study the researcher collected secondary data from various reports, published articles from government institutions and Newspaper articles etc. Also, the collected data is presented through pictorial tools, tables and graphs.

V. ANALYSIS AND INTERPRETATION

A. Government Support for the Development of Electronic Vehicles Ecosystem

In recent years, the Government of India is aggressively pushing sale of electronic vehicles in the country. Various subsidies, information portals and support to develop home grown technology to electric vehicles are provides following are the few major support by government to electric vehicle ecosystem.

- *Fame 1:* The Indian government has started the FAME I scheme on the electric vehicle. the scheme is implemented between 2015-2019. The aim of this scheme is to reduce dependency on fossil fuel and address issue of vehicular emissions, it emphasis the government to provide affordable and environment- friendly public and private transportation for masses and the government focus the area of technology development, demand creation through incentives, pilot projects, charging infrastructure in the Indian society and develop the society towards the modern era.
- *Fame 2:* This FAME II will be implemented by the Indian government in the year 2019 and 2024. In this FAME II the government main aim is to encourage faster adoption of electric and hybrid vehicles, it emphasis the government to make a electrify public transport including shared transport so they decided to focus on the upfront incentive on EV purchase, Charging infrastructure in selected cities and along major highways.
- *E-Amrit Portal:* E-Amrit is a one-stop destination for all information on electric vehicles—gives information for the adoption of EVs, their purchase, investment opportunities, policies, subsidies. The portal has been developed and hosted by NITI Aayog under a collaborative knowledge exchange programme with the UK government and as part of the UK-India Joint Roadmap 2030, signed by the Prime Ministers of the two countries. E-Amrit intends to complement initiatives of the government on raising awareness on EVs and sensitizing consumers on the benefits of switching to electric vehicles. In the recent past, India has taken many initiatives to accelerate the decarbonisation of transport and adoption of electric mobility in the country. Schemes such as FAME and PLI are especially important in creating an ecosystem for the early adoption of EVs.
- *Public Charging Stations:* As per the data available with Bureau of Energy Efficiency (BEE), a total of 6586 Public Charging Stations (PCS) is operational in the country as on 21st March, 2023, out of 6586 Public Charging Stations 419 Public Charging Stations (PCS) are operational across national highway in the country. Under phase-II of FAME-India Scheme, Rs. 1000 Cr. is allocated for the development of charging infrastructure. The Ministry has sanctioned 2,877 electric vehicle charging stations in 68 cities across 25 states/UTs. Further, 1576 charging stations across 9 Expressways and 16 Highways under phase-II of FAME India

Scheme has also been sanctioned.

B. Electric Vehicle (EVs) Sales in India

In India sales number of EVs are growing at a healthy speed. Two-wheelers and passenger car segment is showing double digit growth. Few states transportation department are slowly adopting electric buses for intra city as well as intercity routes.

Table 2: Electric Vehicle Sales in India

Fiscal	Units Sold	YoY Growth (%)
FY2023	11,71,944	155%
FY2022	4,58,746	222%
FY2021	1,42,314	-18%
FY2020	1,73,545	18%
FY2019	1,46,938	52%
FY2018	96,512	73%
FY2017	55,871	245%
FY2016	16,198	590%
FY2015	2,347	-11%
FY2014	2,627	-
Total	22,67,042	-

Source: www.vahan.com Compiled by Autocar Professional

From the above table it is clear that electric vehicle sales in India witnessing a spectacular growth in recent times, in financial year 2022 EV sales observed 222% growth and financial year 2023 also seen 155% sales growth.

Table 3: Segment Wise Electric Vehicle Sales in India

Segment	Units
Two-wheelers	7,20,733
Three-wheelers	3,99,540
PVs (LMVs)	39,562
LPVs	7,045
Buses	1,857
HGVs	193
LGVs	592
Others	2,422
Total	11,71,944

Source: www.vahan.com Compiled by Autocar Professional

From the above table it is found that in India out of all the electric vehicle sold, two-wheeler sale is highest that is 7,20,733 units sold in 2022-23 followed by 3,99,540 units of three-wheelers sold. In India in privet vehicle segment 39,562 units of electric LMVs sold in 2022-23 and overall electric vehicle sales stands at 11,71,944 units.

Table 4: Top 10 Electric Two-Wheeler Company’s Sales in India

Company	Units
Ola Electric	1,51,344
Okinawa Autotech	94,133
Hero Electric	89,165
Ampere Vehicles	83,659
TVS Motor Co	80,565
Ather Energy	76,277
Bajaj Auto	28,098
Okaya EV	13,069
Revolt Motors	12,887
Pure Energy	11,541

Source: www.vahan.com Compiled by Autocar Professional

Above table shows the top 10 electric vehicle manufacturing companies in two-wheeler segment. This segment has highest competition between the companies. Ola

electric is the market leader followed by Okinawa auto-tech and hero electric.

Table 5: Top 10 Electric Car Sales in India

Company	Units
Tata Motors	31,203
MG Motors India	4,412
BYD India	867
Hyundai Motor India	780
Mahindra and Mahindra	396
BMW	382
Kai India	311
PCA Auto India	193
Mercedes-Benz India	152
Volva Auto India	137

Source: www.vahan.com Compiled by Autocar Professional

The above table depicts the top 10 electric passenger vehicle manufacturing companies in 2022-23. Tata Motors is by far a market leader in the segment, they sold 31,203 units. MG Motors India, BYD India, Hyundai Motors India and Mahindra and Mahindra etc are also

C. Aatmanirbhartha in the Ecosystem of Electronic Vehicles in India

To achieve Aatmanirbhartha in electric vehicle ecosystem the government introduced National Mission on Transformative Mobility and Storage scheme. The Mission recommends and drives strategies for transformative mobility and phased manufacturing programs for EVs, EV components and batteries. A Phased Manufacturing Program (PMP) will be launched to localize production across the entire EVs value chain. The National Mission on Transformative Mobility and Battery Storage will determine the contours of PMP, and will finalise the details of such a program. The details of the value addition that can be achieved with each phase of localisation will be finalised by the Mission with a clear Make in India strategy for electric vehicle components as well as batteries. The Mission's objective is then to coordinate with key stakeholders in Ministries Departments and the states to integrate various initiatives to transform mobility in India.

VI. FINDINGS AND SUGGESTIONS

India is witnessing study rise in the movement of electric vehicle industry. From the study it is found that electric vehicle sales are showing good year on year growth. Financial year 2022, EV sales observed 222% growth and financial year 2023 it is also seen at 155% sales growth. But public electric charging station is still less in numbers, a total of 6,586 Public Charging Stations (PCS) is operational in the country as on 21st March 2023 and number of charging stations in national highways also very limited which will lead to the range anxieties among the customers. Future, in India number of electric vehicle manufacturing companies are increasing day by day but they all are dependent on imports when it comes to lithium-ion cells which is critical in battery manufacturing. To improve the electric vehicle ecosystem the following suggestion can be implemented.

- Government needs to focus on increasing the number of charging stations especially in national highways, which



will help to reduce range anxieties among the commuters and will encourage peoples to purchase electric vehicle.

- Battery swapping policy announces in the budget need to be adopted on fast-track basis, which will help to encourage electric vehicle sales in the urban areas.
- The validity of FAME-II subsidy is ending on 2024, in order to support electric vehicle its validity need to be extended beyond 2024.
- In order to achieve Aatmanirbhartha in electric vehicle industry lithium-ion cells battery technology is critical. Indian government need to focus on developing these technologies by investing in R&D and supporting privet sector.
- Finally simple government regulations and clear tax policy for electric vehicle as well as for supporting industries will help to better growth in the sector.

VII. CONCLUSION

Electric vehicles are widely regarded as the future of the automobile industry. To ensure a seamless transition from conventional internal combustion engine (ICE) vehicles to electric vehicles, countries must establish well-developed electric vehicle ecosystems. This necessitates governmental provision of financial and technical support to foster the holistic development of the electric vehicle sector. Key measures include strengthening the manufacturing ecosystem and expanding electric vehicle charging infrastructure. Presently, India relies heavily on other nations for its crude oil requirements, leading to substantial import bills that impede the country's economic growth. Accelerating the adoption of electric vehicles is imperative to address this challenge. Moreover, India possesses abundant lithium reserves, a crucial component in battery manufacturing. Therefore, it is opportune for both the Indian government and private industries to collaborate and spearhead the development of a world-class electric vehicle manufacturing ecosystem. Such efforts will not only cater to domestic needs but also unlock significant export potential, positioning India as a leader in the global electric vehicle market.

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After aggregating input from all authors, I must verify the accuracy of the following information as the article's author.

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