GRINREY

Advances in Electrical and Electronics Engineering

Sandip A. Kale
Editor

Research Transcripts in Computer, Electrical and Electronics Engineering | Volume 01

7 Electric Vehicles Adoption In India: A Comparative Data Analysis of Different States

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ABSTRACT

The best way to provide clean and efficient transport is the electric vehicle (EV). The electric vehicle can reduce the impact of pollution on environment. The rate of adoption of electric vehicles has increased in India but not as per the policy targets. The policies of government of India named as FAME I and FAME II helped so much to take e-mobility initiative in India. This paper explains the different parameters of states regarding EV adoption which can help to understand policy penetration in India. Review of different Scopus journal are used for comprehensive analysis about electric vehicles. Data analysis part of paper helps to understand present conditions of electric vehicle policy implementation among different states. Policy declaration for electric vehicles of many states are stil pending which leads to failure of nationwide adoption of electric vehicles. This study will helpful for policymakers and researcher to get comprehensive review data of different states regarding electric vehicles.

Keywords: Electric Vehicle, policy, scheme, adoption and implementation, India.

Advances in Electrical and Electronics Engineering | ISBN: 978-81-948951-1-4
Book Series: Research Transcripts in Computer, Electrical and Electronics Engineering | Vol: 01

1. INTRODUCTION

Demand of four wheelers has enhanced in India due to likeness of personal mobility. No. of four wheeled cars ranges are available in market in different price segment. [1] Electric vehicles emerged as a clean technology based transportation system and attracted India's policy makers. This technology helped in reducing CO_2 emission through transportation and scale down the air pollution. [2] Electric vehicle is a best alternative of high price fossil fuel based vehicles. The prices of fossil fuels are increasing and its import makes it very unfavorable for India. If the consumption of fossil fuels for transportation will be at same rate then up to 2030 transport emission of GHG (Green House Gases) will increase by 84%. [3] EV development started a hundred year ago but acceptance of people is not reached to a high level. Different technologies of electric vehicles like BEV (battery electric vehicle), HEV (hybrid electric vehicle), PHEV (plug in hybrid electric vehicle) are manufactured by different automotive companies. [4]

India is looking to adopt a large no. of electric vehicles by 2030. The challenges and future opportunities are needed to address by policy makers or researchers because present electric vehicle fleet is less than one percent. Lack of infrastructure development and high cost of electric vehicles are major challenges for high scale market penetration of electric vehicles. [5] NEMMP-2020 (National Electric Mobility Mission Plan) was launched by Government of India in 2013 with a target 6-7 million new electric car selling. If the target is achieved then it will help to save around 2.5 million tones liquid fuel. Advancement in e-mobility sector will create new job opportunities. [6] Government of India take an initiative in 2015 to scale up the use of electric vehicles by adopting a scheme named Faster Adoption and Manufacturing of Hybrid and Electric Vehicle (FAME). [7]

A less matured technology of alternative fuel is required more investment to develop robust infrastructure to compete with the fossil fuel based infrastructure. A specific fund strategy is required to develop for sustainable market for EV (electric vehicle) in developing countries like India. [8] Adoption of proper policies for electric vehicles can enhance its market penetration. [9] It is also required to provide adequate awareness among the people for electric vehicle benefits. For this action it is necessary that government, industrialists, researchers, policy makers, NGOs and other social organization should come together by taking this task as social responsibilities for green environment in future prospective. [10] A standard policy framework is need of hour for electric vehicle market and infrastructure development in India. [11] If the likeness of people and policies of government will move toward electric vehicle then it's a strong possibility that electric vehicle

technology soon replace the IC engine based technology. Some common issues for electric vehicle are battery selection, range of vehicle, electric motor selection, controllers design, charging system design etc. [12]

The best thing with plug-in electric vehicles is that it can use the existing electrical infrastructure for residential EV charging station. [13] Development of adequate charging stations all over the country is a prerequisite thing to do for EV market development. [14] EV range problem is being sorted by investors and manufactures using large size batteries. Charging time is being reduced using DC fast charging stations. [15] Fast charging stations can help to charge EVs in less than 20 minutes. [16] Different type of charging station categories are workplace, corridor, residential and fast charging station. Each category has different business model and among all workplace and residential are simpler than public charging. [17] Rang anxiety of electric vehicle is a major problem in Indian context. Battery swapping station may be a beneficial solution for this but it does require developing robust infrastructure. [18] Reverse supply chain of retired batteries is also required to reduce the cost of maintenance of electric vehicles. Waste disposal model for EVs is also needed to address. [19]

EV ecosystem strengthen initiative can be done by examining the standards, interoperability, policies and business models. [20] Efficient and effective service can be providing by battery swapping station using scheduling strategy. This strategy helps to provide satisfaction and timely service. [21] It is prerequisite to establish well optimized model with proper financial planning to deploy a battery swapping station. [22] Queuing network model can be adopted for battery swapping stations with locally charged mode service. This method is mix of open queue of EVs and closed queue of batteries. [23]

The economic analysis can be done by calculation payback period, internal rate of return and net present value. [24] Different tariff plan and policies affects the return on investment (ROI) parameters for charging stations. Low adoption rate of electric vehicles affects the profit on investment. Policies for profitable business model are needed in India to support investors. [25] Future opportunities are there in electric vehicle with new challenges for automotive industries. Business model uncertainty among stakeholders leads to failure of overall profitable EV business concept. [26]

2. DATA ANALYSIS OF DIFFERENT STATES

Electric vehicle adoption rate in India is very less and to scale up this Government of India (GOI) took many stands and announced many policies. The major policies adopted by GOI are,

Table 1. Different electric vehichle policies

Sr. No.	Year of Adoption	Name of Policy
1	2005	Automotive Mission Plan 2006-2016
2	2010	MNRE Incentive Scheme For EV
3	2013	National Electric Mobility Mission Plan 2020
4	2015	FAME (Faster Adoption and Manufacturing of Electric Vehicles) (Phase-I)
5	2015	Automotive Mission Plan-II
6	2017	NITI AYOG Roadmap
7	2019	FAME (Phase II)

Among these policies National Electric Mobility Mission Plan and FAME Phase-I/II are major policies which helping to enhance EV penetration in Indian automotive market.

2.1 NEMMP 2020 (National Electric Mobility Mission 2020)

The National Electric Mobility Mission Plan (NEMMP-2020) was launched by the Government of India on 9 January 2013 with the aspiration of selling 6–7 million new electric vehicles up to 2020. [27]

2.2 FAME I/II

Faster Adoption and Manufacturing of (Hybrid &) Electric Vehicles in India (FAME-India) Scheme is introduced under National Mission on Electric Mobility. This schemes is under the frame work of demand incentive distribution mechanism. Moniotoring of this scheme is done by NAB (National Automotive Board) under Department of Heavy Industries, Government of India. Total incentive amount disbursed is about Rs 344 Crores for 2.79 Lakhs vehicles. After completion of phase first of FAME scheme Government approved phase second of this scheme from 1st April 2019 with budget of Rs. 10,000 Crore for 3 years. By this scheme target for incentive disbursement for various vehicle categories is created with no. of 7000 e-buses, 5 lac three wheelers, 55000 four wheelers passenger cars and 10 lac two wheelers.[27]

2.3 Registration of Electric Vehicles in FAME-I/II

FAME I scheme was started in 2015 and continued up to 2019 and total no. of registration in this scheme was 280920. Since 2019, FAME-II scheme is continued on place of FAME-I and till now around 24000 thousand EVs are registered under this scheme. In FAME-I scheme highest electric vehicles are

registered in Maharashtra state and under FAME-II scheme till 31 July 2020 highest electric vehicles registered in Karnataka state.[28]

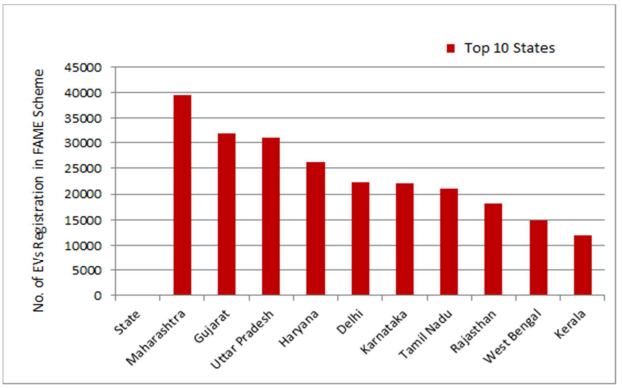

Fig. 1. Top 10 electric vehicle registered states under FAME I and II

2.4 Declaration of State Policies for Electric Vehicles

Six states among top 10 state list have declared policies for electric vehicles. Most of these states declared their policies in 2018 and 2019. The number of electric vehicle registration w.r.t. population is very less. By this data evaluation it can be understand that likeness of electric vehicle is so far as the government targets. [29]

Table 2. Top 10 States policies declaration status

Sr. No.	State	Population	Total No. of electric vehicles registered under FAME-I and FAME-II Scheme	Policy Declared (Y/N)	Policy Declaration Year
1	Maharashtra	112,374,333	39521	Y	2018
2	Gujarat	60,439,692	31868	N	-
3	Uttar Pradesh	199,812,341	30977	Y	2018
4	Haryana	25,351,462	26193	N	-
5	Delhi	16,787,941	22346	Y	2018
8	Karnataka	61,095,297	22045	Y	2017
6	Tamil Nadu	72,147,030	21078	Y	2019
7	Rajasthan	68,548,437	18254	N	-
9	West Bengal	91,276,115	14775	N	-
10	Kerala	33,406,061	11870	Y	2018

2.5 Tariff Structure of Top 10 EVs States

Electricity tariff has important role in EV ecosystem development. This low tariff can help to incresese electric vehicle adoption rate. Delhi, Gujrat, Tamil

Nadu, Maharashtra, Kerala are the states having low EV tariff and this also helps them to be in top 10 EVs registration list.[30]

Table 3. Tariff structure of top 10 no. of EVs states

State	Total No. of EV registered	Tariff		
		EV Tariff (Rs.)	Residential (Rs.)	Commercial (Rs.)
Maharashtra	39521	5.06/kWh	4.6/kWh	3.9 to 4.35/kVAh
Gujarat	31868	4 to 4.1/kWh	1.5 to 5.2/kWh	4.35 to 4.65/kWh
Uttar Pradesh	30977	5.9 to 7.7/kWh	3 to 6.5/kWh	5 to 18/kWh
Haryana	26193	5.58 to 6.2/kVAh	2.7 to 7.1/kWh	6.35 to 7.05/kVAh
Delhi	22346	4.5/kWh & 4.0 /kVAh	3 to 7.75/kWh	8.0/kVAh
Karnataka	22045	5/kWh	7.02 to 7.80/kWh	6.40 to 9.00/kWh
Tamil Nadu	21078	2.50 to 6.60/kWh	2.5 to 6.60/kWh	4.95 to 12/kWh
Rajasthan	18,254	6.00/kWh	4.75 to 7.95/kWh	6.0 to 8.85/kVAh
West Bengal	14,775	7.45/kWh	3.56 to 8.99/kWh	6.17 to 8.94/kWh
Kerala	11870	5.00/kWh	1.50 to 7.90/kWh	5 to 11/kWh

2.6 Electric Vehicle Share of Top 10 States

The major part of total no. of EVs registration are done in some states like Maharasthtra, Gujrat, Uttar Pradesh, Haryana, Delhi, Karnataka, Tamilnadu, Rajasthan, West Bengal and Kerala. These 10 states covers more than 75 percent share of total registration. This shows that only some states are taking electric vehicle adoption seriously. We can understand the same thing using pie chart from fig.2.

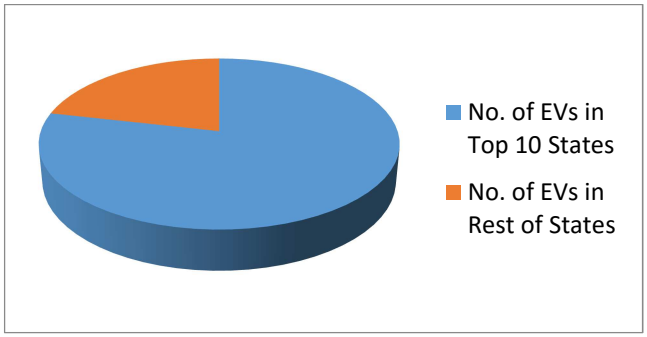

Fig. 2. Share of EV registration in top 10 and others states

2.7 Comparison of Total EV Adoption to Total No. of Vehicles Registered

The rate of total vehicle registration and electric vehicle registration has large difference. If we check the data of total EV registration and total vehicle registration of top 10 EVs registration states than it is only 0.02 percent. This

data analysis shows that it is required to do a large scale awareness work about electric vehicles. This data helps to check the effectiveness of policies and it put a question on state governments policy implementation agencies.

Table 4. Top 10 EV registration states total vehicles v/s electric vehicles data

S.No	State	Population	Total no. of Vehicles registered as per Statistical Year Book India 2018 (Transport + Non Transport) FROM YEAR 2009-2016	Total No. of electric vehicles registered under FAME-I and FAME-II Scheme
1	Maharashtra	11,23,74,333	295539758	39521
2	Gujarat	6,04,39,692	122223991	31868
3	Uttar Pradesh	19,98,12,341	133234440	30977
4	Haryana	2,53,51,462	50971007	26193
5	Delhi	1,67,87,941	62260307	22346
8	Karnataka	6,10,95,297	93312129	22045
6	Tamil Nadu	7,21,47,030	146820763	21078
7	Rajasthan	6,85,48,437	77843349	18254
9	West Bengal	9,12,76,115	39659490	14775
10	Kerala	3,34,06,061	59675899	11870
	Total	74,12,38,709	1,08,15,41,133	2,38,927

2.8 Analysis of Different Parameters of EV Policy of Some States in Terms of Yes/No

Around 10 states has declared their policies for electric vehicles and among them policies of six states are compared based on different characteristics. These six states are in the list of top 10 EVs regsistration states. In electric vehicles policies of these states, various types of schemes are given to consumers, manufacturers, investors. This data analysis part is used to analyze these schemes in terms of yes or no. This will help to understand how these policy schemes are affecting EV adoption rate. [29]

Table 5. Top 10 EV Registration States Total Vehicles v/s Electric Vehicles

Sr. No	State → / Characteristic ↓	Maharashtra	Uttar Pradesh	Delhi	Karnataka	Tamil Nadu	Kerala
1	Charging infrastructure development started	Y	Y	Y	Y	Y	Y
2	Proposed Schemes for Charging Infrastructure	Y	Y	Y	Y	Y	Y
3	Charging infrastructure developed in selected cities	N	N	N	N	N	N
4	Incentive schemes	Y	Y	Y	Y	Y	Y
5	Different Tax Exemption	Y	Y	Y	Y	Y	Y
6	Employment creation proposal in EV field	Y	-	Y	Y	Y	Y
7	Schemes implementation started	Y	Y	Y	Y	Y	Y

8	Ecosystem strengthen	N	N	N	N	N	N
9	Completion of targets as per policy	N	N	N	N	N	N
10	Financial Schemes for Investors	Y	Y	Y	Y	Y	-
11	Ease of business schemes	Y	Y	Y	Y	Y	-
12	Monitoring team for policy security	Y	Y	Y	Y	Y	-
13	R&D proposal in policy	Y	Y	Y	Y	Y	Y
14	Development of successful business model	N	N	N	N	N	N
15	Declaration of tariff structure for EVs	Y	Y	Y	Y	Y	Y
16	Skill development programms proposal	Y	Y	Y	Y	Y	Y
17	Special scheme for 2 wheelers	Y	-	Y	Y	Y	Y
18	Special scheme for 3 wheelers	Y	-	Y	Y	Y	Y
19	Special scheme for electric cars	Y	-	Y	Y	Y	Y
20	Special schems for electric buses	Y	-	Y	Y	Y	Y

3. CONCLUSION

This work includes electric vehicles data of different states which can help to understand the electric vehicles penetration in India. No. of states declared electric vehicles policy but there implementation is still under process. Government of India and state governments are trying with different incentive schemes so that this green transporatation initiative can be a successful step. Different kind of data are used to explain present electric vehicles scenario of different states. Fig.2 explains that a large no. of electric vehicles are adopted by only few states and there is no such awareness among people of other states. It can be understand from table 5 that attractive policies can help to enhance no. of electric vehicles registration. From table 4 it can be said that total electric vehicles registration compare to other vehicles are nearly 0.02 percent that leads to failure of the policies. Low tariff for electric vehicles may be one kind of incentive which can helps to attract public towards electric vehicles. Data analysis based this study may help to identify gap in policy making and its implementation on ground level.

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Cite this article

Shivanshu Sharma and Naqui Anwer, Electric Vehicles Adoption In India: A Comparative Data Analysis of Different States, In: Sandip A. Kale editor, Advances in Electrical and Electronics Engineering, Pune: Grinrey Publications, 2021, pp. 97-106