

STRUGGLES FACED IN THE RESEARCH AND DEVELOPMENT OF ELECTRIC VEHICLES IN INDIA: PRESENT SCENARIO

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Abstract - With an increase in the environmental pollution and a steady increase in the global warming, more attention has been paid to the environmental protection. Due to these concerns, more attention has been paid to renewable energy sources like solar & wind energy as well as new technologies like Electric Vehicles (E.V's). Electric vehicles are generally known as "Zero Emission" vehicles and offer good environmental protection. Electric vehicles in popular media are considered as "Green Transportation" for the 21st century. Car manufacturers, Governments, and Environmental Organizations have started to take more care and invest in the Research and Technology (R&D) of these vehicles. As being stated as "Zero Emission Vehicles" these can drastically reduce the air pollution levels on the earth. So, being the author I assume that these vehicles and the technology should be promoted as well as put to use vigorously in India. However, in spite of enthusiastic political targets and propaganda for the introduction as well as the promotion of electric vehicles in our society, actual sales for electric and hybrid vehicles stay low countrywide. High Price, low-speed, limited range are some of the biggest problems involved with these vehicles. This paper first introduces the demand analysis of the development of the electric vehicles in India followed by problems in the E.V development. Also, the power issues and power demand are covered within this paper associated with these vehicles. At the end, concluding with some suggestions for the development and the counter-measures during the implementation of the technology with respect to the Electric Vehicles (E.V's).

Index Terms - Electric Vehicles, Hybrid Vehicles, Fuel Cells, Batteries, Green Transportation.

I. INTRODUCTION

With the fast urbanization, industrial development, automobile industry development and the increasing car ownership some grave issues like environmental pollution and energy shortage are arising from the automobile industry. These issues need to be given more attention all over the world. To protect the ecosystem and secure the current as well as future energy supplies, governments invest lots of finance, manpower and material resources to find new ways to solve these problems. Electric Vehicles (EV) known as the "Zero Emission Vehicles" have some prominent advantages like zero emissions and high energy efficiency, so EV provides us one of the ways to deal with the human energy and environmental problems in the most effective way.

The prime mover of the Electric Vehicles (E.V's) is an electric motor which takes power from the battery pack transmit it to the electronic controller and then the power goes to the wheels. The Electronic Controller (E.C) is known as the brain of the vehicle as it actually controls the amount of power to be transmitted to the wheels.

EV can be divided into three types:

- A. Pure battery EV
- B. Hybrid EV
- C. Fuel cell EV

II. THE DEVELOPMENT HISTORY OF EV

Currently, the top notch automobile manufacturers invest as well as give more importance to the development of the EV. Developed countries currently invest more heavily in Research and Development (R&D) of E.V in order to promote the development of E.V on a mass scale. Due to some of the serious issues like the performance, range, cost of the battery pack, etc E.Vs have failed to achieve any major breakthrough due to which it has not yet achieved the intended purpose of use.

Hybrid EV because of some of its advantages like the low cost, better driving performance and high energy efficiency are widely recognized as a more affordable vehicle. Toyota Prius and Honda Insight, two Hybrid EVs have already begun the sales in the market. In 1993, the U.S Department of Energy and "Big Three" automakers General Motors, Ford and Chrysler, signed a contract to develop hybrid EV, a period of 5 years of research and development work has been obtaining level sex positive result initial results [1]. In the Fuel Cell EV, transnational strategic alliances have been set up between various countries to promote the development of the E.V. For example:

- A. Toyota and General Motors
- B. Renault and De Nora
- C. Toshiba Corporation and American International Fuel Cells
- D. BMW and Siemens

In India, only some of the enterprises are involved in the development of E.Vs like the Mahindra & Mahindra (M&M) and the Hero Group which are yet to introduce the electric vehicles in the market. Start-ups like Ather Energy and Tork Motorcycles which operate in the two-wheeler segment aren't dealers or manufacturers. They are simply the designers, technologists, and visionaries building a new product for an entirely new segment of consumers in India.

III. THE DEMAND ANALYSIS OF THE DEVELOPMENT OF INDIA'S EV

With the continuous and rapid economic boost in India, more families are now able to afford cars. This entire development leads to a greater possession in the quantity of mobile vehicles in a home. In India, due to a large number of motor vehicles, vehicular exhaust emissions have become one of the most important faced by many big cities in the world. Additionally, crude oil resources in India are very poor due to which the domestic petroleum production can't meet the growing demands of the Indian population.

At the end, concluding that the development of Indian Automobile industry and the Indian Industry as a whole is impossible to achieve a sustainable development which currently relies on the oil imports only. So, India should advance vigorously in the development of EV for the environmental protection as well as the development of the Indian economy.

A. Demand for Environment

With the rapid development of Indian industry and the economy nowadays, environmental pollution has been the major concern of the government. This environmental pollution not only affects the economy but also affects the human health and survival in direct as well as indirect ways. In the last 10 years, the air pollution levels in India have grown to a very large extent which ultimately affects the human health in small as well as big cities. Vehicular Emissions which is responsible for about 25% of CO₂ emitted in India is the main source of deterioration of air quality levels in big cities of India like Delhi, Mumbai, Chennai, etc. Electric Vehicles which are known as the Zero Emission vehicles provides us with one of the ways to maintain and improve the air quality in India.

B. The Demand for High-Tech Industry

The development of EV technology requires the use of various new level industries. Some are chemical, microelectronics, automatic control, power electronics, new power-supply, etc. The development of EV technology will provide a need as well as a motivation to the development of new and high technology industry in India. It will also bring a new

source of income to India. In the energy sector, it will bring the battery, reservoir capacitance, and other relevant industries in India to improve the energy efficiency.

In the terms of technology, India lags far behind the Western Nations. Indian Automobile is considered obsolete in comparison with the Western Automobile Industry. The gap in the field of high-tech automotive technology is very large between Indian and Western Automobile Industry. So, in order to foster the growth of electric vehicles in India, there is a need to develop the Indian Industry.

IV. COMMERCIALIZATION PROBLEMS FACED IN POPULARIZING EV

Although there is a lot of scope of E.V's in future of India but the Government of India has to come forward and solve issues regarding the commercialization of E.V's. In India, most of the people prefer two-wheelers. Electric Rickshaws are becoming very popular these days but the main problems are low-speed, limited range, high price & long charging time. Regarding 4-wheelers these are not at all popular and people still prefer to purchase conventional I.C Engine Vehicles. For example many hybrids E.V's are introduced in India like:-

- A. Mahindra e20:- The e20 comes powered by a 48V maintenance-free Lithium-ion battery, with 25bhp & 53Nm torque. With the top-speed of 81Km/h. Full charge takes 5 hours with a range of 120Km.

Price: (₹ 4.79 lakh - ₹ 5.34 lakh)

- B. Toyota Camry Hybrid: - It has Toyota's DOHC VVT-i 2.5-litre petrol unit, with an electric motor. The output tally is 202bhp; 158bhp from the petrol motor, and 44bhp from the electric motor. Battery-Pack is Nickel Metal Hydride (NiMh). Camry Hybrid gives 19.6Km/l (ARAI figure), which is truly impressive.

Price: (₹ 31.19 lakh)

- C. Mahindra e-Verito: - Mahindra e-Verito is powered by an motor in combination with a 72V battery pack. With a range of 110 km. The EV uses a Lithium-Ion battery and takes 2 hours to be fully charged by the fast charge technology but over 8 hours on regular mode. Its top-speed is 86 km/h.

Price : (₹ 9.50 lakh - ₹ 10 lakh)

V. PROBLEMS IN E.V DEVELOPMENT

Some of the problems faced in the development of E.V are discussed below:-

A. Human Resource Issues

At present, in India, there is insufficient High-Tech Technology, lack of resources and High-Tech industry. Also, India is facing a serious Brain Drain problem with the migration of highly talented students to Western Nations in the name of better life and job opportunities. Electric Vehicle technology needs to be a direction in the future. Technological Innovation must be people-oriented. With the development of E.V Technology center at home, India will be able to gather the first-class talent at home. Also, more industries will be opened in India. Indian Students will be able to enjoy the features of Industry-University Research Alliance so as to better train them with the required technical and management knowledge.

B. The Key Technologies

Regarding the Commercialisation, there is still a pile of issues concerned with the development of E.Vs. For example cost factor, reliability, energy efficiency, durability, environmental adaptability technology, electrical safety, hydrogen safety (in the case of fuel cells), etc. Therefore, it becomes an absolute necessity to focus on these key technologies and speed up the process of E.V development.

VI. POWER ISSUES OF ELECTRIC VEHICLES

Battery charging will be one of the biggest challenges for automotive manufacturers, utilities, customers, and other parties to work through [2]. Various levels of charging options and time taken by EVs are given in Table.1.

Level	Utility Service Charging	Usage	Time to Charge	Charging Power (KW)
1.	110 V, 15 A	Opportunity Based	18 Hours	1.4 - 1.5
2.	220 V, 15 A	Home	8-9 Hours	3.3 - 3.5
3.	220 V, 30 A	Home/Public	4-5 Hours	6.6 - 6.8
4.	480V, 167 A	Private	20-40 Mins	50 - 60

The owner of an EV would most probably like to pursue a charging way faster than the Level1. But Level 1 and Level 2 type of charging would require an approved electricity connection from the State Electricity Board with a proper charging station equipped with the domestic home circuit.

VII. POWER DEMAND OF ELECTRIC VEHICLES

"Plug-in electric vehicle charging is going to affect both electricity distribution company local loads and independent system operator/regional transmission organization regional loads.... From the viewpoint of the electric utility industry, it is important to understand both potential loads and the time frame available for preparation....The availability of daytime charging via public chargers is important to the commercial success of EVs" [3].

The load if everyone charges their E.V at the same time is supposed to exceed several thousands of MW per one million. According to an estimate, it is supposed to exceed around 6,000 MW per 1 million EVs to be deployed in U.S.A in a period of 5 years.

The presence of the E.Vs in global as well as Indian Market will keep on increasing. With such a large number of E.Vs involved it will not be possible to meet the energy demands of all with the present Grids in India. Smart Grids, a concept which will be established by the metering all the connections, instrumentation, etc isn't expected to be completed in the near future. Hence, a huge addition to electricity as well as the resources to the installed grid will be one of the ways to cope up with the demand.

The certainty with which the power demand for other sectors like agriculture, domestic usage, industries, etc can be predicted can't be done with the E.V's. Reasons being the large strength in numbers and a high degree of the variation of electricity associated with the E.V's. Peak Load time will change from days as previous to Nights in the future. Most of the E.Vs will be charged during the night time in order to make them ready for day usage. Due to all these factors, the base load stations may be exposed to highly variable loads, which cannot be managed. The only way to solve this problem will be to install large Reversible Hydro Power Plants in the grid [4].

CONCLUSION

Rapidly increasing pollution has raised new concerns regarding the environment. In spite of enthusiastic political targets for the introduction of electric maneuverability, actual sales for electric and plug-in hybrid vehicles stay low. The high price tag and

Limited range are some of the problems associated with E.Vs which gives them a serious blow when compared with the conventional vehicles. So, the time has finally come to introduce pollution free E.V's. But the main challenge is customer satisfaction & it will only be obtained when issues like high cost, limited range, etc will be solved through research. Also, there is a need to develop the Indian Automobile Industry because the issues regarding the human resources, key technologies, infrastructure problems, etc as discussed above give a serious blow to the development of E.Vs. India needs to heavily invest in the electricity generation like Hydro-Power Plants, Renewable Energy, Nuclear Energy, etc to meet the growing demands of the electricity in our country and also to feed the electric vehicles with this electricity generated. At the end, it becomes necessary to modify

the present Indian Industry and Power Generation Sector for the development and commercialization of the electric and hybrid vehicles for the public transportation.

REFERENCES

- [1] Guo, P., & Liu, P. (2010, October). Research on development of electric vehicles in China. In Future Information Technology and Management Engineering (FITME), 2010 International Conference on (Vol. 1, pp. 94-96). IEEE.
- [2] L.Dickerman and J. Harrison, "A New Car, A New Grid", IEEE Power & Energy, Vol.8, No.2, pp.55-58, Mar.-Apr. 2010.
- [3] E. Ungar and K.Fell, "Plug in, Turn on, and Load up", IEEE Power & Energy, Vol.8, No.3, pp.30-35, May-Jun. 2010.
- [4] Rupchand, K. V. (2011, July). A proposal for meeting power demands of electric vehicle transportation in India. In Power and Energy Society General Meeting, 2011 IEEE (pp. 1-5). IEEE.

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