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A Review on Future of Electric Vehicles in India

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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). The transport sector is one of the biggest emitter of CO₂ and hence it is very important to convert the sector to a green sector. Indian government has come up with ambitious plans of introducing the EVs to Indian market and keep in pace with the development of EVs globally. Electric vehicles are generally known as "Zero Emission" vehicles and offer good environmental protection. Electric vehicles in popular media are considered a "Green Transportation" for the 21st century.

KEYWORDS: CO₂ emission, Electric Vehicles, Hybrid Vehicles, Fuel Cells, Batteries, Green Transportation

I. INTRODUCTION

Electric vehicle (EV) is a road vehicle propulsion. With this broad definition in mind, electric vehicles may include battery electric vehicles (BEV), hybrid electric vehicle (HEV) and fuel cell electric vehicle (FCEV). Electric vehicle is a multi-disciplinary subject which covers broad and complex aspects. However, it has core technologies, namely chassis and body technology, propulsion technology and energy source technology. The article begins with reviewing the status of BEV and HEV, then focusing on the engineering philosophy of EV development. Subsequent to the illustration of the configurations of both BEV and HEV, it discusses rather detail the major technologies, namely the propulsion technology, energy source technology and infrastructure technology. Finally the commercialization aspects are discussed. The conclusion summarizes the state of the art and the challenges of BEV, HEV and FCEV.

Today BEV, HEV and FCEV are in different stages of development, facing different challenges and require different strategies. It can be seen that the critical issue of BEV is the battery. Therefore, BEV is mainly suitable for small EV for short range low speed community transportation, thus requires only smaller battery size. HEV can meet consumers' meet but cost is the major issue. FCEV has long term potential for future main stream vehicles, however the technology is still in early development stage, its cost and refueling system are the major concerns.

boost converter shows in Fig. 2, it is second order circuit having an inductor, a resistor and a load resistance connected parallel with the capacitor [5]

1. WHY ELECTRIC VEHICLES?

Let us begin with the investigation of the growth of population and vehicles. In the next 50 years, the global population will increase from 6 billions to 10 billions and the number of vehicles will increase from 700 millions to 2.5 billions. If all these vehicles are propelled by internal combustion engines, where will the oil come from? And where should the emissions be disseminated? Would the sky be permanently grey? The gloomy answers to these questions compel people to strive for sustainable road transportation for the 21st century. In a world where environmental protection and energy conservation are growing concerns, the development of electric vehicle (EV) technology has taken on an accelerated pace to fulfill these needs. Concerning the environment, EVs can provide emission-free urban transportation. [1].

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. Forexample:

- A. Toyota and GeneralMotors
- B. Renault and DeNora
- C. Toshiba Corporation and American International FuelCells
- D. BMW andSiemens

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[2].

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.

3.1 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.

3.2 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. PAST, PRESENT AND FUTURE OF EV'S

4.1 Past Years Development

EV was invented in 1834. During the last decade of the 19th Century, a number of companies produced EVs in America, Britain, and France. Fig 2 shows the London Electric Cab Company's taxi. Due to the limitations associated with the batteries and the rapid advancement in internal combustion engine (ICE) vehicles, EVs have almost vanished from the scene since 1930. In the early 1970's, some countries, compelled by the energy crisis, started the rekindling of interests in EVs. In 1976, the USA launched the Electric and Hybrid Vehicle Research, Development and Demonstration Act, Public Law 94-413. At that time, the main question to be answered was "Can EVs do the job in our modern society?", although EVs did work well in the late 1800's and early 1900's. The development of EVs for over years has answered the above question - yes. For example, an experimental EV in 1968 racing from California Institute of Technology (Caltech) to Massachusetts Institute of Technology (MIT) suffered from failures in virtually every critical component; whereas a commercially built EV in 1998 running from Los Angeles to Detroit exhibited a success with no component failures. Within the 1970's, EVs were still in research and development stage, and most of them were conversion of internal combustion engine vehicles (ICEVs). Today, major automobile manufacturers are offering EVs for sale or lease. Most of them are the purpose-built EV, not conversion EV.

4.2 present of Ev's

At present, the major driving force for EVs is the environment issue, such as mandate by California rule, rather than the previous energy issue. Thus, the main question to be answered becomes "Can EVs be made affordable?". The major factors that make EV affordable are the range and cost. To tackle the range, the development of advanced batteries such as the nickel-metal hydride, zinc/air and lithium-ion are in progress. However, since both specific energy and energy density of batteries are much lower than that of gasoline, the development of fuel cells for EVs has taken on an accelerated pace in recent years. Meanwhile, the development of commercial hybrid electric vehicles (HEVs) is also going on rapidly. HEVs essentially improve the range and performance of EVs at higher complexity and cost because of the additional energy source, engine and other accessories. To tackle the cost, efforts are being made to improve various EV subsystems, such as electric motors, power converters, electronic controllers, energy management units, battery chargers, batteries and other EV auxiliaries, as well as EV system level integration and optimization

4.2 future of EV's

In order to see the development trends of various EV aspects, a survey has been made with respect to the number of papers published on various topics in leading Ev related international conferences from 1984 to 2000. With regard to propulsion system, it was observed that the research papers on induction motor drives (IM) and permanent magnet motor drives (PM) are highly dominant, whereas those on DC motor drives (DC) are drooping while those on switched reluctance motor drives (SR) are still in a crawling stage. With regard to the development trend of various energy sources, including leadacid batteries (LA), nickel-based batteries (NB), lithium-based batteries (LB), fuel cells (FC) and capacitors/flywheels (CF); the number of papers published in LB, FC and CF are becoming more and more attractive, though LA and NB are still undergone continual improvement. With regard to the configurations of EVs, it was observed that the conversion EV is becoming less attractive than the purpose-built EV while the HEV is of growing interests for the coming EV markets. It was also observed that EVs are on the verge of commercialization, since more and more papers were published on the topics of demonstration as well as standardization and marketing of EVs. In the next few decades, it is anticipated that both EVs and HEVs will be commercialized, and they will have their market shares. EVs will be well accepted by some niche markets, namely the users for community transportation, the places where electricity is cheap and ease of access, and the places with zero-emission mandate. On the other hand, HEVs will have a niche market for those users desiring long driving ranges. The ultimate penetration of EVs and HEVs



will mainly depend on their respective costs. Particularly, the research and development of FCEVs will be accelerated in the next two decades, since they have the good potential to deliver the same range and performance as our ICEVs.

V. PROBLEMS IN E.V DEVELOPMENT

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

5.1.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.

5.2.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. CONCLUSION

India has a huge challenge in shifting the transportation sector from ICE engines to EVs. This requires a lot of planning, research and development. Government policies like FAME and few other policies need to be updated on regular basis to keep in pace with the development throughout the world. India should focus on improving the energy-efficiency of EVs. The power electronics, electric motors should be planned for Indian conditions. A battery eco-system needs to be developed which can support many companies and start-ups developing battery pack up and cell manufacturing. Charging infrastructure needs to be adequately built to address range anxiety. The options of swapping also be explored. It is also very important to create demand generation by making all government buses electric and offering tax exemptions for private EV owners.

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