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Trends and Challenges in Electric Vehicles

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ABSTRACT : This paper gives a general overview of Trends in electric vehicle. History of EV, World market for the EV. Different countries current EV trend, electric vehicle in Indian market, Key developments, government support for EV, challenges, benefits of increasing EV. Electrification of automotive powertrain is one of the main trends in current vehicle development. The growing threat of global warming, excessive petrol dependence, ever increases prices in fuel, and driving trends are just a selection of reasons which have accelerated the development of Electric Vehicles also The transport sector represents a critical percentage of greenhouse gas emission. Transport emissions are estimated to increase by 84% to 2030[2]. Key technologies such as hydrogen fuel cell, electric cars and bio fuels are expected to contribute to emission reduction in the long run. Aim of this study is to compare and analyze the development of market, government support for the trend. And to accelerate the trend to save the nation, world from pollution.

KEYWORDS: Trends in electric vehicle, sales of EV in different countries, government support for EV sales growth and challenges.

I. INTRODUCTION

The growing threat of global warming, excessive petrol dependence, ever increases prices in fuel, and driving trends are just a selection of reasons which have accelerated the development of Electric vehicles (EV). As a means to meet ambitious CO₂ reduction targets defined by politics, to avoid penalty fees and to account for changes in the awareness of customers concerning environmental issues, a variety of different propulsion concepts are developed [1].

The transport sector represents a critical percentage of greenhouse gas emission. Transport emissions are estimated to increase by 84% to 2030[2]. Key technologies such as hydrogen fuel cell, electric cars and bio fuels are expected to contribute to emission reduction in the long run. Key interests have been attracted to discuss future trends in green vehicle. Major car manufacturers seek leadership in future green vehicle markets.

The purpose of this report is to describe the trends in electric vehicles how the electric vehicle concept is growing in the present market and the reason it is a necessity to better the world today. The report describes the key technology development in electric vehicle, electric vehicle in the Indian market, government initiatives in the EV space benefits of increased electric vehicle deployment challenges in electric vehicle.

The paper begins with a trends in the electric vehicle, growth in the trend, international Action to promote electric vehicles, benefits of increased electric vehicle deployment and the challenges in the electric vehicles.

II. HISTORY OF ELECTRIC VEHICLE

Electric Vehicles (EV) are powered exclusively by a battery that is recharged from the electric utility grid. In every decade or so, like in today's energy climate where gasoline prices have risen dramatically, policymakers and the public become aroused by the prospect of battery-powered vehicles. Although EVs sound like an unusual concept in today's internal combustion engine (ICE) vehicle world, EVs have been around for about 170 years. The first EV was invented way back in the 1830s and, when battery storage improved later in the 19th century, EVs began to flourish. In fact, in the early part of the 20th century, EVs outsold ICE vehicles because they were easier to start, quieter than and not as smelly as gasoline cars. But, as roads improved and, with the discovery of crude oil in Texas, the gasoline cars took over. Later in the last century, the U.S. petroleum crisis of the 1970s was an event that spurred interest in the

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development of EVs. in 1976, congress passed public law 94-413 that mandated the introduction of 10,000 EVs on U.S. roads in five years.

The 1990s brought yet another policy initiative that focused considerable attention on market introduction of EVs. In September 1990, the California Air Resources Board (CARB) enacted the Zero Emission Vehicle (ZEV) Mandate that required manufacturers to sell 2% EVs in 1998, ramping up to 10% in 2003. The ZEV Mandate was very unpopular with automotive manufacturers, especially General Motors, Ford and Chrysler [3]

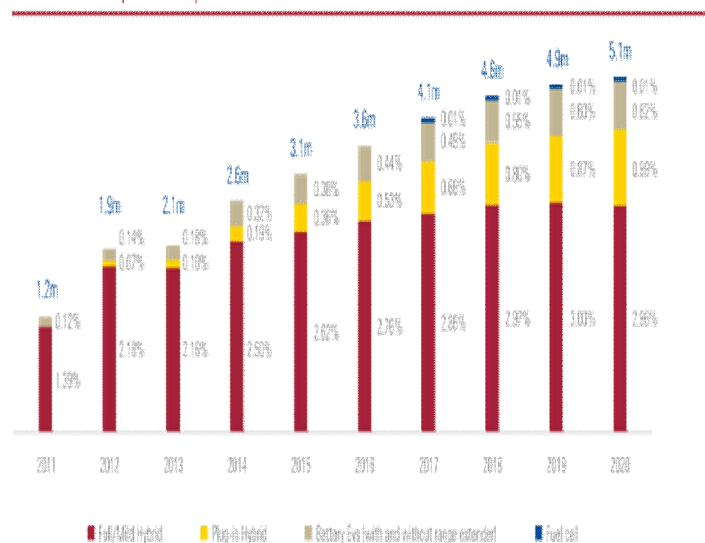
III. TRENDS IN ELECTRIC VEHICLE

Electric Vehicles (EVs) have been on the radar of the government and globally. According to the 2015 Global Automotive Executive Survey done by KPMG International, by 2020, less than one in 20 vehicles is expected to be equipped with electrified powertrains. The plug-in hybrid and battery EVs are expected to capture a smaller portion of the pie, followed by fuel cell electric cars that have the least share. By 2020, only 0.01 per cent of cars are expected to be equipped with fuel cells i.e. about 16,000 units per annum [4].

The number of electric vehicles sold each year globally is growing rapidly from 45,000 units in 2011 to more than 300,000 units in 2014. The global electric vehicle cumulative registrations grew at a CAGR of 92 per cent to reach a total of 665,000 electric cars on road, by 2014. The United States of America held the largest share, with the world's biggest fleet of e-vehicles, followed by Japan and China. Globally, 320,000 electric cars were registered last year, of which 117,000 cars were registered in the United States followed by China at 54,000. China is one of the fastest growing market for EVs, with 230 million e-bikes, 83,000 electric cars, and 36,500 e-buses on road by 2014.

Battery stations should charge the customers (every time when they come to exchange the batteries) for recharging batteries, small calculated amount for replacing of the batteries after their life and their fixed profit margin. The best way is to collect the cost for replacements of the batteries after its life while purchasing the electric vehicles itself. The cost should be collected less considering the interest of the amount paid at start. This will be like an insurance policy which is a single payment but lifetime membership. To ensure a high-quality product, diagrams and lettering MUST be either computer-drafted or drawn using India ink.

Global electrified powertrain production trend: 2011-2020



Source: KPMG's Competence Centre Automotive, LMC Automotive

Fig.1

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Based on ADEME, 2010; BMUB, 2014; governor’s interagency Working group on Zero-emission Vehicles, 2013; CARB, 2011; CEM, 2015b; IEA, 2011; METI, 2010; MIT, 2015; NESCAUM, 2014; OLEV, 2013; Ontario, 2009; U.S. Doe,2011.

Region	electric vehicle cumulative sales target by 2020 (or before, as specified)	electric vehicle cumulative sales target for post 2020
Canada(Ontario)	0.3 million	
China	3 million	14 million(2025)
Denmark	0.2 million	
France	1-2 million	
Germany	1 million	6 million(2030)
India	6-7 million	
Japan	0.6 million	1 million(2030)
Netherlands	0.2 million	1 million(2025)
Norway	0.05 million(2018)	
South Korea	0.2 million	
Spain	1 million(2014)	
Sweden	0.6 million	
United Kingdom	0.5 million	
United States	1 million(2015)	
United states (eight states)		3.3 million(2025)
United States (California)	0.5 million	1.5 million(2025)

Table: selection of national electric vehicle sales goals for 2020-2030

ELECTRIC VEHICLE TREND IN INDIA

The Electric Vehicle industry in India is far behind, with less than 1per cent of the total vehicle sales. Currently, Indian roads are dominated by conventional vehicles (ICE) and have approximately 0.4 million electric two-wheelers and a few thousand electric cars only. The Indian EV industry has been on the back seat due to various challenges that are similar to the global EV industry. High cost of batteries and cars has been a major obstacle to the widespread consumer adoption of EVs in India. Lack of Inexpensive and robust charging infrastructure is another parameter which has hindered its growth.

A typical electric car in India costs around INR0.5 to 0.6 million which is approximately 2.5 times higher than an entry level fuel efficient conventional car. Also the battery life of the EV is approximately four to five years and the replacement cost is around INR0.2 to 0.3 million, which further adds to the cost of ownership. Besides price, another barrier that has prevented the widespread adoption of EVs is range anxiety.

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Total electric vehicles sold in India

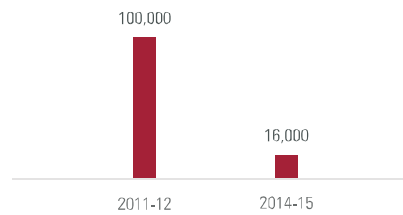


Fig.2 Total electric vehicles sold in India
Number of electric two-wheeler makers in

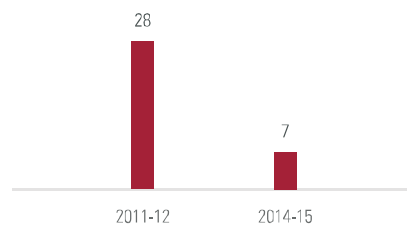


Fig.3 Number of electric two-wheeler makers

We believe that more than 100 years after the invention of the internal combustion engine, incumbent automobile manufacturers are at a crossroads and face significant industry-wide challenges. The reliance on the gasoline-powered internal combustion engine as the principal automobile powertrain technology has raised environmental concerns, created dependence among industrialized and developing nations on oil largely imported from foreign nations and exposed consumers to volatile fuel prices. In addition, we believe the legacy investments made by incumbent automobile manufacturers in manufacturing and technology related to the internal combustion engine have to date inhibited rapid innovation in alternative fuel powertrain technologies. We believe these challenges offer an historic opportunity for companies with innovative electric powertrain technologies and that are unencumbered with legacy investments in the internal combustion engine to lead the next technological era of the automotive industry.

INDIAN CURRENT SCENARIO:

Large scale introduction of Plug-in electric vehicles (PEVs), including plug-in hybrid electric vehicles (PHEVs) and Battery Electric Vehicles (BEVs) have the potential to improve Indian energy and environmental landscape of personal transportation. Central government should start enforcing necessary measures to install EV charging infrastructure. Initial step could be to encourage international market players to make case studies on potential locations and adequate quantity of Electric Vehicle Supply Equipment (EVSE). With a projection of EVs, the effects on current, energy production, transmission and distribution scheme, road traffic density, emission level and parking space requirement need to be analysed. Operation and maintenance of installed infrastructure should be maintained properly. Instead of direct involvement of Govt. body, private players should be tendered in order to maintain the smooth work flow. Central management through Charging Station Selection server (CSS) will play a vital role in information transfer between EVs-Server-Control centres.

INDIAN GOVERNMENT SCOPE FOR EV

The electric and hybrid vehicle industry in India, which is at a nascent stage, is slowly creating opportunities for automotive original equipment manufacturers (OEMs), according to Frost & Sullivan. The subsidies from the Government has supported electric vehicle (EV) industry so far, however the same could have been more consistent for the overall market growth. However, the Indian government's plan to re-introduce incentives for electric vehicle buyers

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is expected to revitalise the market. The foray of more automotive manufacturers into the Indian electric and hybrid vehicle industry too will subsidise charging infrastructure and quicken market expansion.

According to Frost & Sullivan's new study, 'Strategic assessment of electric and hybrid vehicle market in India', the total electric and hybrid vehicles market is expected to grow from 1,25,257 units in 2013 to 1.1 million units by 2021 at a compound annual growth rate of 31.6%. Domestic and international vehicle manufacturers are expected to launch more than 25 EV models by 2021.

This new move by the Government can be described as the biggest push to encourage sales of electric and hybrid vehicles in India. Under a unique and innovative scheme named as FAME, Government will provide incentives up to Rs 1.38 lakh for every electric car sold.

Union Minister of Heavy Industries and Public Enterprises, Anant Geete, launched Faster Adoption and Manufacturing of (Hybrid &) Electric Vehicles in India (FAME) aiming at promoting and encouraging sale of electric and hybrid vehicles.

The launch program of this scheme was organized by The Department of Heavy Industry (DHI) under the Government of India, along with the Society of Indian Automobile Manufacturers (SIAM).

It was announced that the Government aims to bring 6-7 million (60-70 lakh) electric and hybrid vehicles on road by 2020. For the next 5 years, the ministry has estimated that Rs 14,000 crore would be required to successfully implement the scheme. As of now, Rs 795 crore has been allocated which will be utilized under Phase 1, which has been again broken down into two 1-year period: 2015-16 and 2016-17. Out of Rs 795 crore budget, Rs 500 crore would be utilized for giving incentives alone [11].

- Government will set up the Governing Council for Electric Vehicles
- Operate under the Ministry of Heavy Industries and Public Enterprises
- It will develop infrastructure for electric mobility - charging stations
- Council to have representatives from various Ministries – includes Road Transport and Highways, New and Renewable Energy and Power and also industry representatives.
- Promote Joint Ventures, esp. in EV battery manufacturing & technology transfers.

OTHER COUNTRY INITIATIVE IN EV SPACE

CHINA:

China's efforts to grow the electric vehicle market include research and development, regulatory incentives, public vehicle procurement, vehicle production subsidies, consumer incentives, and public charging investments. Since the 2000s, China has spent more than \$1 billion per year at the national level in R&D loans and grants, plus an additional \$1 billion from local governments and industry (OECD, 2015). From 2009, China shifted toward a focus on incentives for manufacturer production, public procurement (e.g., fleets, taxis), and private consumer subsidies for electric vehicles, first in 10 particular cities and later 25 (Howell et al., 2014; OECD, 2015). The incentives generally have not been available to foreign-manufactured electric vehicles. Of the leading electric vehicle models in China in 2014, 15 of the top 16 are domestically produced (EV Sales, 2015). China's electric vehicle growth was slow from 2010-2013, but growth in 2014 brought China's electric passenger vehicle sales to more than 50,000 per year, behind only the United States in total national annual sales.

JAPAN:

Japan is among the leaders in early electric vehicle growth with more than 30,000 sales in 2014. Japan has goals for plug-in electric vehicles to make up 20%-30%, and fuel cell electric vehicles 3%, of total vehicle sales by 2030 (METI, 2010). Japan's share of hybrid electric vehicles is far higher than other countries around the world; this hybrid success could provide an example of how comprehensive support policies (e.g., R&D, efficiency standards, consumer fiscal incentives) can help support the development of a market for advanced technology (see sidebar). As part of its electric vehicle promotion efforts, Japan also has several consumer incentives and substantial electric vehicle charging infrastructure in place. Incentive programs allow for a one-time subsidy and purchasing tax exemptions for EVs and other qualified fuel-efficient vehicles since 2009. The subsidies are based on the price difference between an EV and a comparable gasoline car, with a maximum of 850,000 yen (about 6,300 euros) (see CEV, 2015; Mock & Yang, 2014). These incentives generally amount to about 3,000-5,000 euros for typical BEVs and PHEVs. Japan also has reductions

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and exemptions for BEV and PHEV acquisition and annual tonnage taxes that can nearly double those upfront incentives for the first vehicle owner (Mock & Yang, 2014).

UNITED STATES:

With more than 100,000 sales in 2014, the U.S. had the highest electric vehicle sales of any country. The U.S. set a goal of 1 million cumulative electric vehicles by 2015 and is about a third of the way to that goal. National policies to promote electric vehicles include consumer subsidies and infrastructure investments. A federal income tax credit grants from \$2,500 per PHEV (for about 10-15 mile range) up to \$7,500 for longer-range PHEV (at 16 kWh battery, or about 40-mile PHEV) and BEVs. Federal funding for an expansive national public electric vehicle charging network has helped in the rollout of more than 20,000 charge outlets at 8,000 stations (U.S. DOE, 2015). The U.S. also has a growing workplace charging network that includes more than 100 employers, 250 workplaces, and more than 4,000 chargers (U.S. DOE, 2014).

EUROPE:

There is a great diversity of electric vehicle promotion activity across Europe. Common to the European Union member states, vehicles are all promoted by the increasingly stringent carbon dioxide emission standards that aim to achieve a 95 g CO₂/km new vehicle fleet in 2021, and these regulations provide further promotion for electric vehicles with “super credits” and the omission of upstream emissions (Mock, 2014). European countries have installed various levels of electric vehicle charging equipment in order to improve the value proposition, electric range, and range confidence of electric vehicle users. The EV wide Clean Power for Transport directive provides targets for each member state regarding the increased deployment of plug-in charging and hydrogen refuelling infrastructure (European Commission, 2014). Some European countries have also established bold targets, offered large fiscal incentives to consumers, installed vehicle charging networks, and implemented other support policies to promote electric vehicle deployment. Also, each of the European countries has had higher gasoline and diesel prices of about 1.50-1.80 euros per liter in 2013-2014 that inherently have provided greater fuel savings and a stronger relative motivation for alternative fuel vehicles (Mock & Yang, 2014).

BENEFITS OF INCREASED IN ELECTRIC VEHICLE DEPLOYMENT

Governments around the world are attempting to surmount the prevailing barriers and accelerate the electric vehicle market for various reasons. The anticipated benefits and the common barriers that stand in the way of the emerging electric vehicle market are summarized to provide further background for the report.

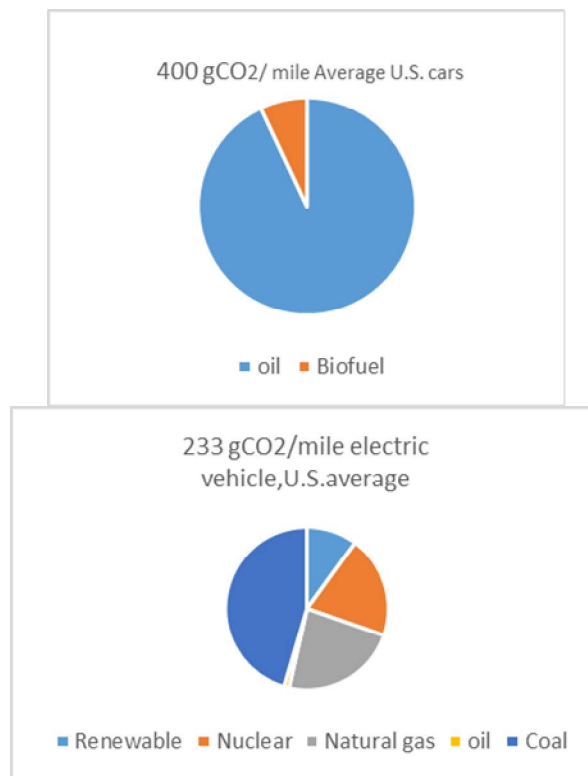
Compared to conventional vehicles, electric vehicles have two fundamentally superior technical features: greater on-vehicle efficiency and greater upstream energy source flexibility. Electric vehicle use, defined as the percentage of energy delivered to the vehicle that is ultimately used to overcome the vehicle road load, is about 4 times more efficient than conventional internal combustion gasoline engine efficiency, which is about 10%-20%. Conventional gasoline and diesel vehicles have greater thermodynamic energy losses, friction losses, fuel pumping losses, accessory loads, and transmission losses. The use of other alternative fuels, such as biofuels, can offer low-carbon energy sources but has supply limitations and is subject to the same combustion inefficiency disadvantage. On the other hand, electric-drive vehicles avoid most of these losses on the vehicle by using highly efficient electric powertrains, in addition to allowing for reduced upstream fossil energy use. As shown, moving from mostly fossil to 50% renewable energy sources for electricity further reduces the primary fossil-based energy requirements of electric vehicles.

Electric vehicles, beyond consuming less energy, enable greater use of low-carbon and renewable energy sources than are available from conventional petroleum-based fuels. These technical advantages lead to the potential for greatly reducing petroleum use, air pollution, and carbon emissions.

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CHALLENGES IN ELECTRIC VEHICLES

The problems are the challenges of the electric vehicle

- Battery life is less (3-4.5 years): For this challenge the battery should be designed so that the battery will work effectively, efficiently and any environment.
- Frequent recharging of battery: For this the battery capacity is to be increased with less space consuming battery should be implement.
- Recharging time is high (6-8hr): Existing electric vehicle should be kept 6-8 hr for complete recharging for this challenge the different methods have to obtain for fast charging of battery.
- Access for recharge is not easily available outside the home For this challenge the government and manufacturer have to provide the charging station like petrol station.

For the above mentioned challenges, researches are continuously going in the industry , many research on the fast charging of battery ex: Mahindra Reva are using the fast charging technique available in Kempegouda International airport Bengaluru. Like this the industry and the government is working on the challenges to increase electric vehicles.

IV. CONCLUSIONS

Electric Vehicles are also one of the best option for transportation. By this report Trends in electric vehicle have to increase in Indian market for reduction of pollution in country. By this we got to know about current key developments, Trends of Electric vehicles in global market. In this U.S. has maximum Percent of Electric vehicle compare to other country, what are the next plans for increasing Electric vehicles in their country.

Indian market current scenario for Electric vehicles. Why Indian market is for behind in this trend, what are the scopes are given by Indian government for increasing Electric vehicles also manufacturer support, what are the works are going on in this field for implement strong base for Electric vehicle market in India.

In this report China, Japan, U.S. Europe country scope for electric vehicle. Their next estimations, by that how

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much pollution their going to reduce, all are discussed in this report.

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