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Consumers Perceptual Mapping about E-vehicle: Analysing Opportunities and Challenges with Special Reference to M.P.A

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Abstract

Favoured policies and initiatives has led Indian governmentto become one of the leading automobile manufacturers across the globe,contributing majorly to its production. Despite this achievementpublic transport still remains an important means of transport in small cities,towns and rural areas.These means of transport has severely contributed to startling air pollution rates in all major cities of India.Showing worryover the burgeoning pollution problem, and understanding that the transformation to a more environment-friendly and reusable source of energy is the need of the moment, the Government of India, over the last few years, has been increasingly publicising alternative mobility solutions, chief among which are electric vehicles. EVs are emission-free and therefore, hold the key to India's alarming air pollution issue.Using electric bus for public transportation could be right step towards modernization and also reducing carbon emissions.This paper analysis various perceptions ,opportunities and challenges related to e- automobiles in India with special reference to M.P.

Keywords: *e-vehicle, eco-friendly, renewable source, pollution, modernization.*

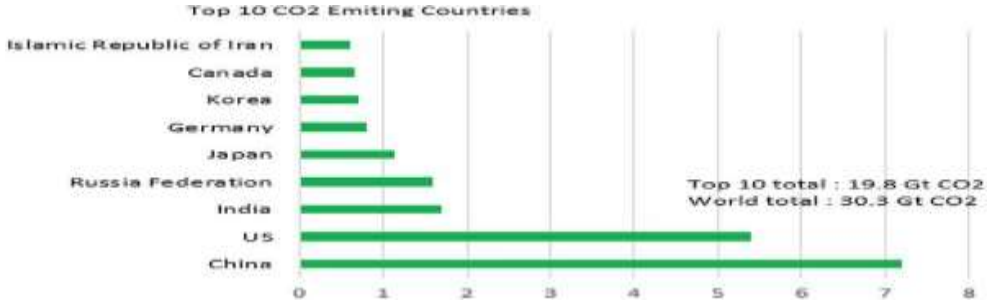
INTRODUCTION

EVs are environment friendly as they are emission-free and therefore, hold the key to India's ever increasing air pollution problem. The Government of India, has been increasingly promoting eco-friendly vehicles because they are powered by electricity and are pollution free. Along with it , GOI has also revealed the "National Electric Mobility Mission Plan (NEMMP) 2020" in 2013.This plan envisages a number of alternatives and plan of action focussed towards speeding the adoption of eco – friendly vehicles in India. By 2020 the plan, essentially, aimed to deploy around 7 million hybrid and all-electric vehicles in the country. This plan, however, has been extended beyond 2020, due to economic compulsions.

In January 2017, to promote manufacture of electric technology the central government said that it would bear up to 60% of the research and development (R&D) cost for developing the indigenous low-cost electric vehicle. As a motivating measure, the government has recently reduced GST on manufacture of e-vehicle

Auto industry is one of the leading sectors which drives economic growth of the country. In the year 2017,more than 25 million vehicles were produced which included all types of vehicles two wheeler, three wheeler, commercial and passenger resulting in 5.41% increase as compared to PY. This huge increase in salesled to increase in pollution level too.

Another important aspect is public transport ,even today small cities and rural population are heavily dependent on public transport for commutation. This excessive use of public transport means huge increase in pollution level. According to a report by Greenpeace, 'Over 1.2 Million deaths occur in the country every year as a result of air pollution'. Thereforeit becomes utmost necessary to use pollution free and reusable source of energy and electric vehicle could be the only alternative.



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Global EV Outlook, International Energy Agency-IEA Report 2016

The electric vehicles are contoured with batteries which can be charged using electricity. These batteries store power to run a set of electric motors, which pushes the car forward. An electric car is significantly quieter and offers a smoother ride than conventional car as it is devoid of clutch, gearbox and even an exhaust pipe. Fully charged, standard EV is capable of covering a distance between 150 km to 170 km.

One of the chief options of electrical vehicles is that they can be plugged into off-board power sources for charging.

There are two types of EVs: i) All Electric Vehicles (AEVs) which consist of Battery Electric Vehicles (BEVs) and Fuel Cell Electric Vehicles (FCEVs). They are fully charged electrical vehicle and they are charged from electric grid and are usually capable of generating electricity through regenerative braking .They do not consume petroleum, therefore they do not produce emission. . The second type is ii)PHEVs (plug-in hybrid electric vehicles).These are charged by gasoline and are attached with battery and motor for better efficiency. A battery, which can be plugged into the electric grid for charging which can be used to power the electric motor, while gasoline which helps drive the internal combustion engine.They utilise electricity for short periods (around 9.6 to 64.3 km), once the battery is depleted, they switch to the internal combustion engine for greater speed and range. Hydrogen fuel cells, biofuels or some other kind of alternative fuel can be used as alternative eco-friendly plug in hybrid.

The third category is iii) conventional hybrids such as Toyota Prius, which can't be classified as EVs because they usually cannot be plugged-in.

RESEARCH METHODOLOGY

Objective of the Study

1. To study the consumers perception about e-vehicle.
2. To study the co-relation of income on the use of e-vehicle
3. To study the impact of age on the use of e-vehicle.
4. Tounderstand the opportunities and
5. To evaluate the challenges associated with it.

Hypothesis :1

Null :Ho :There is no significant and positive correlation between consumer perception and e-vehicle .

Alternative :H1:There is a significant and positive perception of consumers regarding e-vehicle.

Hypothesis:2

Null :Ho : There is no significant and positive correlation between Income and usage of e-vehicle

Alternative : H1 :Income is positively and significantly co-related with e-vehicle.

Hypothesis:3

Null :Ho : Age is not significantly and positively correlated with the use of e-vehicle

Alternative H1: Age is significantly co-related with use of e-vehicle.

Sampling

Madhya Pradesh was chosen as universe sample.Selective sampling of working males ,working females and students was done.Questionnaire was prepared through google forms and sent to selected sample.Around 500 responses were received.Out of this 250 responses didi not fit into the study and around 100 responses were unfit for consideration.Finally 150 responses were considered for the survey and primary data were collected and their responses analysed through chi-square test.This analysis is very unique because out of the total respondants majority are females 55% and males 45%.This research presents the opinion of the female working class population**.**

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LITERATURE REVIEW

Su-Hau et al (2004) focused on the highly efficient battery energy usage and proposed an integrated management system for electric motor which included the power-saving controller, energy management subsystem and some hardware protection strategies. This also acts as a supervisor to manage all the events about the battery energy, including the residual capacity estimation and regenerative braking operation.

David and Sheng-Chung (2004) proposed new parallel-type hybrid-electric-power system comprising an engine's energy distribution and a torque-integrated mechanism .To let the engine achieve maximum thermo-efficiency with minimum emissions, the system is applied with a stable engine-load to maximize operating performance. The vehicle is driven by the motor alone in the light-duty mode. The engine output is fixed, but the motor output power can be controlled.

Wenguang et al (2005) presented an approach to control powertrain of series hybrid electric vehicles. They also proposed a new switching algorithm for the power converter for motor torque and motor flux control. The sliding mode method is applied to excitation winding control in synchronous generator to achieve the desired current distribution in powertrain.

Yimin and Mehrdad (2006) introduced a speed and torque coupling hybrid drivetrain. In this drivetrain, a planetary gear unit and a generator/motor decouple the engine speed from the vehicle wheel speed. They also discussed the fundamentals architecture, design, control, and simulation of the drivetrain. Simulations show that the fuel economy in urban and highway driving cycles can be greatly improved.

Kuen-Bao and Tsung-Hua (2006) incorporated a mechanical type rubber V-belt, continuously-variable transmission (CVT) and chain drives to combine power of the two power sources, a gasoline engine and an electric motor in hybrid power system. The main advantages of this new transmission include the use of only one electric motor/generator and the shift of the operating mode accomplished by the mechanical-type clutches for easy control and low cost. Kinematic analyses and design are achieved to obtain the size of each component of this system. A design example is fabricated and tested.

Markel and Simpson (2007) discussed the battery power and energy requirements for grid-charged parallel hybrid electric vehicles with different operating strategies. First, they considered the traditional all-electric range based operating concept .They then proposed an alternative electric-assist operating concept for grid-charged HEVs to enable the use of a smaller, less costly battery. However, this strategy is expected to reduce the vehicle efficiency during both charge-depleting and charge-sustaining operation.

Gonder and Markel (2007) analysed the energy management strategy for the operation of hybrid electric vehicles. They summarised three potential energy management strategies and compares the implications of selecting one strategy over another in the context of the aggressiveness and distance of the duty cycle over which the vehicle will likely operate.

Yimin and Mehrdad (2008) discussed the design and control methodology of plug in hybrid electric vehicle. Their design methodology focused on battery energy and power capacity design. They tried with Ni-MH and Li-ion batteries. Also their control strategy focused on all-electric range and charge-depletion range operations..

Emadi et al (2008) focused more on power electronics as an enabling technology for the development of plug-in hybrid electric vehicles and implementing the advanced electrical architectures to meet the demands for increased electric loads. A brief review of the current trends and future vehicle strategies and the function of power electronic subsystems are described and are also presented.

E-Vehicle: Benefits

Are easy to maintain: Because electric cars are powered by electricity and not gasoline, it drastically reduces the monthly spending of car owners. Although the initial cost of electric cars is quite higher than that of conventional vehicles, in the long-run, it is actually cheaper to own and maintain EVs.Are more eco-friendly and less carbon emissions:Electric cars are 100% emission free as they run on electrically powered engines. All electric cars particularly the ones powered by renewable energy are much better than hybrid cars. However, in this regard, it should be noted that the source of electricity is also of importance in case of EVs. If the electricity is produced through environmentally-damaging means like coal power plants, which is often the case in developing countries, the environmental benefits of electric cars ultimately get

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negated.Curbs sound pollution :Electric vehicles tend to be more silent than conventional vehicles due to less number of components. This, in turn, helps in curbing sound pollution, particularly in huddled urban areas. As an additional advantage, electric motors, being lighter, offer a smoother drive with higher acceleration over longer distances than cars running on fossil fuels.

Drawbacks

Range Anxiety, Lack Of Charging Infrastructure :Despite the huge technological advancements, EV charging infrastructure remains inadequate in most parts of the world. Furthermore, most electric cars have a range that falls between 150 to 175 km on a single charge. In the absence of charging points, especially during low-distance drives, there is the risk of being stranded, which albeit can be avoided through battery swapping. However, for widespread adoption of EVs, governments around the world need to be more proactive in building a robust and well-connected charging infrastructure. Long Charging Times : The charging process of EVs can take anywhere from 30 minutes (in case of fast charging) up to 24 hours, depending on the capacity of the battery and motors. Most, however, take around four to six hours to be fully charged, which is several times longer than the time it takes to refuel a petrol/diesel car. Lower Battery Life, High Battery Costs :The batteries currently used in electric vehicles have a lifespan of around three to 10 years, depending on the make and model. The lower battery life usually is a hindrance that affects the performance of electrical cars.The higher costs of batteries, which are caused by the insufficient supply of raw materials, add to this problem.

ANALYSIS

My research was conducted on a wide spectrum of respondents ranging from 18 years to 38 years and above and across the state of Madhya Pradesh. It included both male and female ,employed and students. Looking at the responses ,a summary of report is as follows;

Total respondents 150

(A) Age of respondents

Age	Below 18	18-22	23-27	28-32	33-37	Above 38
%	4.7	14.8	22.8	25.5	18.8	13.4

(B) Employed Status

Status	Student	Employed
	23.6	76.4

(C) Income level of respondents

Income level in lakhs p.a.	Below 10	Between 10-20	Above 20	No Income (students)
%	14.1	25.5	36.2	24.2

(1)

Own car	Yes	No
%	67.6	32.4

(2)

People having electric car	Yes	No
%	20.1	79.9

(3) The major reasons for purchasing electric car

Influential factors	**Very Influential**	**Moderately influential**	**Not influential**	**I don't Know**
Price	75	60	8	6
Size	51	70	16	9
Fuel Efficency	76	47	17	8
Perfomance	55	69	15	8
Cheap car insurance	52	68	24	5
Cheap road tax	47	68	24	10

ISSN: 2005-4238 IJAST

Low cost of ownership	53	69	20	7
High resale value	45	69	26	9

(4) People ready to spend for an ordinary car

Amount people are willing to spend	%
Less than Rs. 250000	20.8
Between Rs. 250000 to Rs. 499999	9.4
Between Rs. 500000 to Rs. 749999	22.1
Between Rs. 750000 to Rs. 999999	22.1
Between Rs. 1000000 to Rs. 1249999	22.8
Above Rs. 1250000	2.7

(5) Amount spent on electric car.

Amount people are willing to spend on electric car	%
Less than Rs. 250000	20.8
Between Rs. 250000 to Rs. 499999	9.4
Between Rs. 500000 to Rs. 749999	22.1
Between Rs. 750000 to Rs. 999999	22.1
Between Rs. 1000000 to Rs. 1249999	22.8
Above Rs. 1250000	2.7

(6) Environmental conscious

	Yes constantly	Yes , a lot of time	Sometimes	Occasionally	No
%	24.3	35.1	28.4	11.5	0.7

(7) Benefits of electric car

	Fuel eco-nomy	Less carbon Emiss-ions	Depen-dency on fossil fuels	Performs well	Inexpen-sive to run	Looks good	Public-city	Other	Not sure	No benefits	All of the above
%	35.6	61.1	63.1	39.6	35.6	17.4	6	0.7	1.3	2	0.7

(8) Drawbacks of using electric car

	Recharging takes time	Recharg-ing is inconvenient	Initial cost of purchase	Style/ design	Limited choice	Power delivery	Stigma of an electric car	Image	Other s	No drawbacks	None of these
%	25.5	43.6	47.7	45	40.9	22.8	7.4	5.4	2	2.7	0.7

(9) Do you think that electric cars are a good return on investment?

Yes	No	Don't Know
67.6	15.5	16.9

(10)Do you plan to buy an electric car in the future?

Yes	No	Don't know
56.8	25	18.2

(11)How long until you plan to purchase an electric car?

0 to 6 months	6 months to 1 year	1 to 2 years	2 to 4 years	4 years or more	Not sure
2.7 %	6.1%	16.3 %	18.4%	29.3%	27.2%

(11).Do you think that it is too early for electric cars, they are not reliable enough, and you would prefer buying an hybrid car (using both fuel and electricity)?

Yes	No
53.7 %	46.3 %

Hypothesis :1

ISSN: 2005-4238 IJAST

Null :H o :There is no significant and positive correlation between consumer perception and e-vehicle .

Alternative :H 1:There is a significant and positive perception of consumers regarding e-vehicle

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	27.318	17	.054
Likelihood Ratio	34.417	17	.007
Linear-by-Linear Association	.304	1	.581
N of Valid Cases	149		

Hypothesis:2

Null :Ho : There is no significant and positive correlation between Income and usage of e-vehicle

Alternative : H1 :Income is positively and significantly co-related with e-vehicle.

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	3.289	3	.349
Likelihood Ratio	3.220	3	.359
Linear-by-Linear Association	.102	1	.750
N of Valid Cases	149		

Hypothesis:3

Null :Ho : Age is not significantly and positively correlated with the use of e-vehicle

Alternative H1: Age is significantly co-related with use of e-vehicle.

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	11.478	5	.043
Likelihood Ratio	12.329	5	.031
Linear-by-Linear Association	9.726	1	.002
N of Valid Cases	149		

FINDINGS

Age ,income and status plays a major role in perception towards purchase of e-vehicle.

(A) 50% age group is between 23 -37.This research has shown that age plays a crucial role in developing perception about the use if e-vehicle.

(B) Majority of the respondents were employed people and their income earning capacity help in deciding their perception towards e-vehicle.

(C) 75 % of the respondants are employed people .Majority of the employed people earn income above 10 lakhs p.a.The income also plays a very important role in the perception mapping towards the use of e-vehicle.

(1) As per the research conducted majority own their car,but very few have electric car.

(2) Majority of population have their own car.

ISSN: 2005-4238 IJAST

(3) Price and fuel efficiency are the two very influential factors for purchasing an electric car.All the other factors like size performance, insurance are moderately influential factors.

(4) Majority are ready to pay between Rs 500000 and Rs 1249999 for an ordinary car

(5) Same as above they are ready to invest for electric car.

(6) 35% people are environmentally conscious.

(7) Majority are aware that use of fossil fuel is the main cause of pollution, therefore using ev will reduce dependency on them and also reduce carbon emisssions.

Hypothesis 1
The value of chi-square statistics is 27.318 for 17 degree of freedom and the p value of .054 is almost equal to 0.05(p=.05). Hence, there is a significant and positive perception of consumers regarding e-vehicle.H=1 is accepted.H=0 is rejected

Hypothesis 2
The value of chi-square statistics is 3.289 for 3 degree of freedom and the p value of .349 is greater than 0.05 (p>0.05). Hence, there is no significant and positive correlation between Income and usage of e-vehicle.H=0 is accepted.

Hypothesis 3
The value of chi-square statistics is 11.478 for 5 degree of freedom and the p value of .043 is less than 0.05 (p<0.05). Hence, Age is significantly co-related with the use of e-vehicle.

MAJOR CHALLENGES FOR INDIA
Given the current environment, there have been several speculation of diesel engines dying in 2020 and electric vehicles becoming the new milestone. But it remains a very big challenge for India because of some major factors:

Electricity Production: Load shedding continues to be a major problem in rural India and also small towns and cities. Power cuts can create problem for electric vehicles. Besides luxury cars like Mercedes –Benz EQC require high tech fast charging options which is very expensive. Similar technologies cannot be applied in budget car segment costing between Rs 10-15 lakhs. Since most of the India car consumer belong to this segment, manufacturers have to strike a balance between making EVs usable and affordable .Irratic electric supply and power cuts can seriously damage hardware including the battery .Gradually it may be possible to make this technology India friendly, but it would require large economies of scale (large production to reduce cost) and this is possible if government provides incentives to manufacturers.

Government Support: If the buyers and the manufacturers have to be motivated to purchase and cater to the demand of electric vehicles respectively, then the government must make electric vehicle more lucrative to buy with changes in policy. The manufacturers would also hesitate to invest if there is lack of government support. Imported electric car would also defeat the very purpose as it may be very expensive. While the government has expressed favourable sentiments towards EVs, nothing has been put down in policy. Even the 2030 deadline to make each new vehicle electric was a statement, not a policy that carmakers could take as a guarantor. This made it more difficult for manufacturers (domestic or foreign) to take firm decision on investment needed to develop and manufacture electric cars in India. Importing cars would not solve the purpose.

Domestic Battery Supply:The biggest value in any electrical vehicle is the battery pack. At the instant, battery producing corporations like BYD, Tesla and Panasonic aren't based mostly in Asian country, it is nearly entirely imported.To make EVs affordable, the batteries will have to be produced in India and be extensively tested to cope with Indian weather conditions And this makes battery usage very costlier.

Dealer Reluctance: A car dealer makes the real money on the expenses that surround the car itself - accessories, insurance, service expenses and others rather than car sales. Electric vehicles don't have as many moving parts and don't have requirements like engine oil, injector clean ups, or tuning. So they are very cheap .Wear and tear parts like seat and tyres can still wait replacement, but electric

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powertrains are far less complicated and far more efficiently designed than their internal combustion engine-equipped counterparts. Given the limitations in service areas, dealers will expect an alternative revenue source.

Robust Support Infrastructure: The mass adoption of electric vehicles mandates a robust charging infrastructure, just like conventional vehicles rely on petrol pumps or gas stations for refuelling . Also called electric vehicle supply equipment (EVSE), the EV charging stations are often installed by utility companies as on-street facilities. Other similar facilities like public destinations and even workplaces can be operated by private companies. Even in major cities, residential areas, offices or pay and park locations there is no infrastructure to support for electric vehicle charging. Additionally, actual charging stations are far and few in between. The choice of LPG vs CNG is common in Asian country and a significant deciding issue is fuel handiness**.** Limited design and choices could also be major problem. Recharging points and intial cost of purchase are the other drawbacks .

OPPORTUNITIES

With the comparison of the merits and the demerits of the EVs, It is noticeable that these vehicles are the mode of transport for our next generation. Keeping in mind the merits of EVs, the demerits are nominal as this is the safe and clean source of the transport. Following opportunities should be implemented on priority status for solving this grave issue.

1. Building of Basic Infrastructure: Govt. of India should prepare a long term plan for the development of charging station for all over India.
2. Phase wise Implementation: Govt should prepare a phase wise long term plan for this process, after the development of the required infrastructure.

For example :

- First Phase for 3 to 4 year for Public Transports
- Second Phase for 3 to 4 years for four wheelers
- Third Phase for 3 to 4 years for two and three wheelers

3. EVs Industries treated a Priority Sector: Government of India should include this industry in priority sector industries list, to get easy credit facilities from the banks.
4. Tax Incentives: Government of India should minimise the tax liability on this industry for 10 to 15 years.
5. Benefits to present Automobile Industries: Government should provide financial and technical support to present automobile industries, so that they can transform.
6. Subsidy Schemes: The government should provide subsidies in the use of electric vehicles so that customers can look for alternatives.
7. Establishment of new plants for battery production by public , private sector companies and by multinational companies in India to reduce the cost of battery.
   8 Promotion of Research and Development activities , provision of subsidy and other tax incentives for the customer of EVs to increase the use and promotion of Foreign Investment in this field
   Conclusions
   As we all know the traditional vehicles are the main cause of the pollution and a threat to the human health and the use of the EVs is only alternate available for the purpose of transport.In India the main concern is the cost of EVs along with the cost of their batteries and lack of the proper infrastructure. For the solution of these issues we need effective and efficient long term planning. With this plan and the support co-operation of public, automobile industry and Government. our country can adopt this mega conversion program.

In India, despite a myriad of challenges and obstacles, electric vehicles (EVs) are steadily gaining traction, thanks in part to favourable government initiatives and the entry of international players. There are still quite a few challenges that need to be overcomed to make EVs ready for mass adoption.

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EVs are going to be a stepping stone towards intelligent, futurist transport infrastructure in India that's capable of producing business to the quality demands of the country's immense population.

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