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Electric Vehicles and India Recent Trends in the Automobile Sector

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A B S T R A C T

With the current depletion of fossil fuels and its rise in pricing there is a need to find an alternate energy resource to run the vehicle. The automobile sector is proceeding towards Electric vehicles as a solution to the industry and environment in India. However, the current market of EVs is relatively low despite governments implementing EV policies. Through this paper ease of Electric vehicles in India will be studied and the compatibility of EVs in India will be analyzed..

Keywords: Electric vehicles, Internal-combustion engine, Retrofitting, Convectional vehicles, challenges in adoption of electric vehicles, Ease of use, government policies

1. Introduction

India stands third in the world with the largest road connection. Traveling by the road is a preferable choice for Indian people almost 60% of the population used personal or shared vehicles to travel (Statista,2020) Petrol and Diesel are major causes of global warming and environmental air pollution. Diesel Vehicles Are Responsible For 66 percent Of Air Pollution-Related Deaths In India. This study has exposed serious health risks from transport emissions in India and particularly from diesel emissions. (Study by Environmental Expert)

Multiple initiatives have been taken by the Government of India to promote manufacturing as well as the adoption of EVs. This has led to increased penetration of EVs in the Indian market. By 2030, the government aims to make India a 100-per cent electric vehicle nation.

It has proposed that two-wheelers below the engine capacity of 150cc sold in the country after March 31, 2025, and three-wheelers sold after March 31, 2023, should be EVs. (transport policy) FAME India is a part of the National Electric Mobility Mission Plan. The main purpose of FAME is to encourage electric vehicles by providing subsidies. Objectives of FAME Schemes are to Encourage faster adoption of electric and hybrid vehicles by way of offering upfront Incentives on the purchase of Electric vehicles.

Establish a necessary charging Infrastructure for electric vehicles. To address the issue of environmental pollution and fuel security. (FAME policy.)

The National Electric Mobility Mission Plan (NEMMP) 2020, Under NEMMP 2020, Government has launched Faster Adoption and Manufacturing of (Hybrid &) Electric Vehicles in India (FAME India) scheme to promote manufacturing of electric and hybrid vehicle technology. The main objective of NEMMP is to Achieve national energy security. Mitigation of the adverse impact of vehicles on the environment.

Growth of domestic manufacturing capabilities in the automobile sector. (NEMMP policy.)

2. LITERATURE REVIEW

Electric Vehicles: A Synthesis of the Current Literature with a Focus on Economic and Environmental Viability: Marcello Contestable, Dr. Gregory Offer, Dr. Robin North, A research concludes that the longer-term uptake of EVs will depend heavily on progress in battery technology, to bring down costs and increase energy density, and on the provision of a suitable recharging infrastructure. (Marcello Contestable, 2012[1]

Potential Need for Electric Vehicles, Charging Station Infrastructure and its Challenges for the Indian Market: by Praveen Kumar and Kalyan Dash, India should invest in small-scale reinforcements to manage the load issues locally rather than going for an enormous change. Home charging should be encouraged. Proper planning of place, population, traffic density, and safety should be considered before implementing the massive scale charging infrastructure. The integration of activities within the energy and transport fields is important. Development goals through different innovative policies and programs, for instance, drivers of electrical cars are offered a financial consumer incentive, like tax credits, purchase subsidies, discounted tolls, free parking, and access to restricted highway lanes will help the market to grow. (Dash P. K., 2013)[2]

Conventional, Hybrid, or Electric Vehicles: Which Technology for an Urban Distribution Centre?: by Philippe Lebeau, Cedric De Cauwer, Joeri Van Mierlo, Cathy Macharis, Freight transport has a major impact on urban movement. The researcher explored the possible integration of electric vehicles in urban logistics operations. A fleet with different technologies has the opportunity of reducing the costs of the last mile. The researcher presented a fleet size and mix vehicle routing problem with time windows for EVs. The main contribution of the
authors was considering the variability of the range of EVs. In the segments of small vans, EVs are often the most competitive technology. In the segment of large vans, diesel has seen the most interesting solution from a financial point of view as electric vehicles would need to cover a longer distance to be cost-competitive. Hybrid vehicles are chosen in the segment of trucks as their running costs and fixed costs are lower than a diesel truck. (Philippe Lebeau, 2015)[3]

Consumer preferences for electric vehicles: by Fanchao Liao, Eric Molin & Bert van Wee, Widespread adoption of EVs may contribute to a lessening of problems like environmental pollution, global warming, and oil dependency. However, this penetration of EV is
comparatively low despite governments implementing strong promotion policies. They presented a comprehensive review of studies on consumer preferences for EV aiming to convey policy-makers and give direction to further research. They compared the economic and psychological approach towards consumer preference for Electric vehicles. The impact of the financial and technical attributes of EV on its utility is generally found to be significant, including its purchase and operating cost, driving range, charging duration, vehicle performance, and brand diversity on the market. The density of charging stations also positively affects the utility and promotion of EV. The impact of incentive policies, tax reduction is quite effective. (Fanchao Liao, 2017)[4]

International Council on Clean Transportation: Lingzhi Jin, Peter Slowik, The early market growth for electric vehicles continues, but several barriers prevent their widespread uptake. These barriers include the additional cost of the new technology, relative inconvenience of technology considering range and charge times, and consumer understanding about the availability and viability of the technology. This last point, typically referred to as “consumer awareness,” is crucial. (Lingzhi Jin, 2017)[5]

Study on Electric Vehicles in India Opportunities and Challenges: by Mohamed M, G Tamil Arasan, and G Sivakumar, The replacement of ICE with electric engines will reduce pollution to a great extent and be profitable to consumers. Many countries have implemented this technology and are contributing to the improvement of the environment. The researcher saw the opportunities and challenges faced in India over implementing EVs. Opportunities like Government Initiatives, Batteries, Industries, and Environment have been considered. These challenges like the cost of EVs, the efficiency of EVs in India, and demand for EVs were taken into consideration. The implementation of EVs in India aims primarily to scale back greenhouse emissions and cut oil expenses. The govt. should make the foremost out of the opportunities available and find suitable ways to tackle the challenges. (Mohamed M, 2018)[6]

Electric Vehicles in India: Market Analysis with Consumer Perspective, Policies and Issues: Pritam K. Gujarathi, Varsha A. Shah, Makarand M. Lokhande, Indian Scenario is different because the current market share of EV/PHEV is around 0.1%. Presently almost all vehicles consider fossil fuel-based transportation. These pollute the atmosphere by the emission of greenhouse gases & causes global warming. The gap between domestic petroleum production and consumption is widening. India imports around 70% of oil required per annum. Hence there's an urgent need to investigate factors and challenges for sustainable and cleaner alternatives. (Pritam K. Gujarathi, 2018)[7]

Perception and Awareness Level of Potential Customers towards Electric Cars: Masurali. A Surya P, India contributes around 18% in the transport sector alone in terms of compared to combustion-engine vehicle carbon emission. The Electric Vehicle (EV) is one of the foremost feasible alternative solutions to beat the crises. Several automotive companies are introducing EVs and are expanding their portfolio. Promoting EVs can help reduce fuel dependence and pollution and beneficial for both consumers and the nation. The education of people has a significantly higher influence over their awareness level on

EVs. Apart from manufacturers, Government should strive hard to spread awareness and influence positive perceptions among potential customers. (Masurali. A, 2018)[8]

A Study of Consumer Perception and Purchase Intention of Electric Vehicles: Pretty Bhalla, Incas Salamah Ali, Afroze Nazneen, Choice of cars depends upon environmental concern, cost, comfort, trust, technology, social acceptance, infrastructure availability. These arguments have been tested for both conventional cars and EVs. They assume that these factors have a direct influence on individual choice of vehicle. They found that EV manufacturers and Government have to invest more in social acceptance of the vehicle by creating more infrastructural facilities, putting more thrust on technology to create trust. The analysis depicts that the population is well aware of the environmental benefits. The responsibility lies on the shoulders of the Government and manufacturers to invest in technology and of people's concerning the manufacturing of vehicles. (Pretty Bhalla, 2018)[9]

Electric Vehicles for India: Overview and Challenges: by Mr. A. Rakesh Kumar, Dr. Sanjeevikumar Padmanaban, Global pollution is on the rise and each effort made, is to cut back the CO2 emissions and save the earth. One such effort is the introduction of EVs. The transport sector is one of the largest emitter of CO2 and hence it's important to reduce it. The government has come up with ambitious plans of introducing EVs to the Indian market and confine pace with the event of EVs globally. The National Electric Mobility Mission Plan 2020 has included an in-depth report on EVs. India encompasses a huge challenge in shifting the transportation sector from ICE engines to EVs. This needs lots of planning along with R&D. Charging infrastructure must be adequately build to deal with range anxiety. It's vital to form demand generation by making all government buses electric and offering tax exemptions for personal EV owners. (Mr. A. Rakesh Kumar, 2019)[10]

Opportunities and Scope for Electric Vehicles in India: by Janardan Prasad Kesari, Yash Sharma, Chahat Goel, Developing an aggressive strategy for the adoption of EVs in India and ensuring a well-executed implementation is a challenge but vital for the government. The geography and diversity of India will present problems that require thoughtful solutions. Public procurement is expected to be an important driver of the growth of EVs, with the purchase of four-wheeled vehicles for government offices, three-wheeled vehicles, and buses for public transport. Investments by fleet operators such as Ola and Uber, and operators of food distribution services, are also expected to boost the initial growth of two- and four-wheeled electric vehicles. However, private EVs may take 5-6 years to gain popularity and acceptance. (Janardan Prasad Kesari, 2019)[11]

Indian Electric Vehicles Storm in a teacup: Yogesh Aggarwal, Vivek Gedda, and Kushan Parikh, Users of scooters, who need only to travel short distances, may consider an EV, but those, who need to travel longer distances and already own bikes like a Hero Splendor, may find it difficult to move to an e-2W. For cars, it is relatively simple to improve the range with increased battery size. For electric 2Ws though, every increase in kWh may provide an extra 30km in range, but the increase in weight is around 10kg, approximately a 10% increase in the total weight of the bike. This weight issue is even more pronounced in smaller bikes (less than 150cc). (Yogesh Aggarwal, 2019)

3. OBJECTIVES

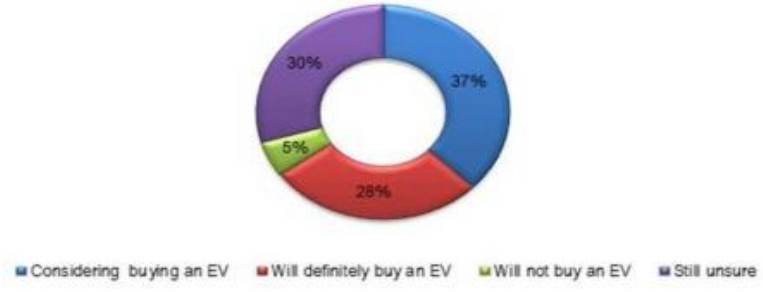
The objective of this paper is to understand the importance of electrical vehicles with consideration ofEnvironmental factors.

- It also aims to study the perceptions and expectations of potential, for alternative technologies inautomobiles, such as Electric To study the current expectations of consumers concerning Electric/Hybrid Vehicles, this will lead to its potential for the future.
- As well as changing people's perception of buying electric vehicles and making India GO GREEN. Also making people aware about the RETROFITTING technology and also about the various technologies adapted by the big giants in the industry and their reviews and their better alternatives.

4. CURRENT SITUATION AND DATA ANALYSIS

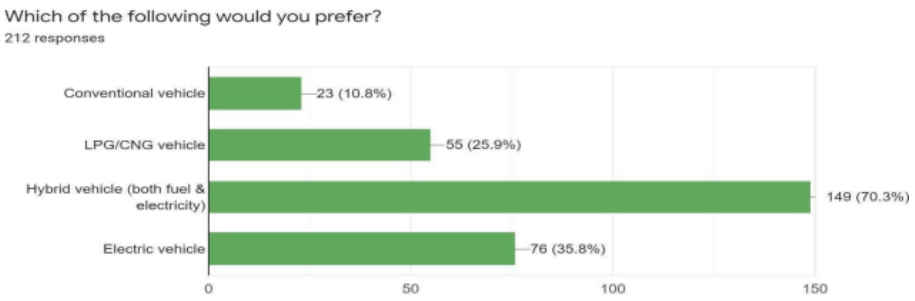
Descriptive research methodology is used. Primary data of a sample population of 212 is collected using an online questionnaire. The environmentalChi-square test is used to test thehypothesis.

1. Based on the desire of Indian people willing to adopt Electrical cars.

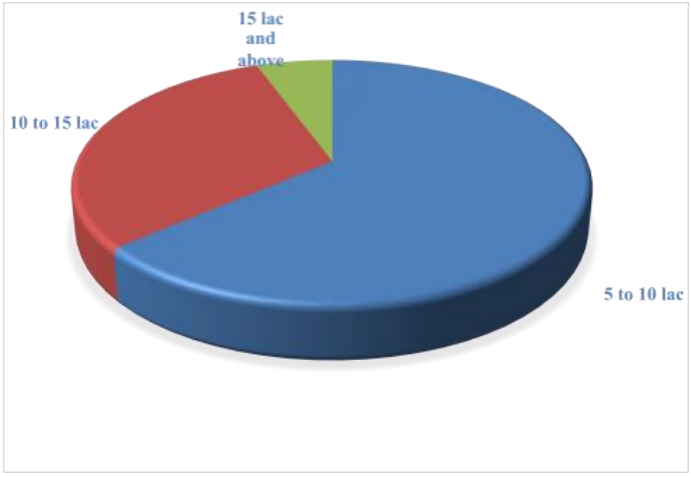


37% were in favor of eco-friendly vehicles and **5%** are Favored for not adopting the EV.
28% of people are in favor to buy electric vehicles. And **30% of** people are still unsure.

2. Survey based on the choice of fuel

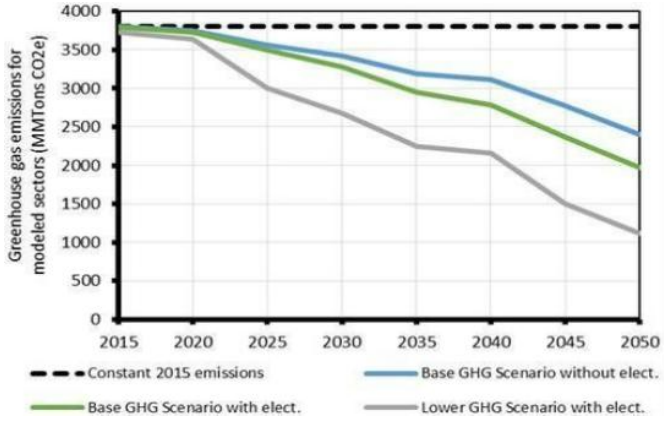


3. Survey based on costing issue



Cost being an important factor, the customer expects EVs in the 5-10 lakhs range. Some expect to be pricing between 10 to 15 lac, and some expect to be above 15 lac.,

4. Data based on less or zero Emissions by Electrical Vehicle.



5 Managerial Implications

Several implications emerge for not only marketers and manufacturers of EVs but also the governmentfrom this study.

EV adoption in India is right now in a nascent stage; people are unfamiliar and hence may be skepticalfor a move towards EV. Preference for EV will evolve as technology advances, and as familiarity, penetration, and SoC. In improve.

Decisive governmental policy on EVs and well-articulated incentives applicable to early adopters (manufacturer and consumer) will play a significant role in switching to EVs.

ATT emerged as the main factor, which influenced EV adoption. Hence, EV manufacturers and marketers need to work on transforming ATT in a positive direction towards EVs. Appropriate incentivization is also essential since as per the results Perceived economic benefit (PEB) also affectsBI via ATT.

The environment is a concern for all, Central and State governments, and every human being, regardless of their stature. The introduction of green license plates on EVs can symbolize concern for the environment, and support with financial incentives such as free or concessional toll, parking, or priority at public places may enhance adoption.

Hence, marketers' communication in addition to the above should highlight the expected features like

- Functional information such as range covered per battery charge, battery life, and maximumspeed along with Quality specifications.
- However, additionally,How the customer can affect the environment positively by adopting EVs.
- Incentives as applicable for adopting EVs.

5. RETROFITTING

What is Retrofitting

Retrofitting is the process of converting a combustion engine vehicle into an electric one, and presentsa huge opportunity for India since electric vehicle production will take some time to scale.

Potential of Retrofitting

A study by Ola Mobility Institute in 2019 said that central government e-mobility targets for 2030 canonly be achieved when the incentive provision goes beyond the purchase cost of electric vehicles.

The Total Cost of Ownership includes the direct and indirect costs of purchasing, running, and maintaining the electric vehicle. With these overheads, the cost of ownership is significantly higher forelectric vehicles at this point, especially since the charging infrastructure is not robust.

Delhi-based startup BharatMobi launched the 'Bharat Kit', which is designed to convert conventional vehicles into electric. The customized battery, part of the kit, gives an average speed of 80 kilometersper hour after being charged for four to five hours.

In an interview with News18, Akbar Baig, Co-founder of BharatMobi shared, "With the Bharat Kit, your car becomes a pollution-free, gearless, noiseless vehicle. This kit goes perfectly with a wide range of cars and offers a smooth, efficient, and fuel-free drive."

Loop Moto is another startup that provides a compact electric powertrain with Lithium-ion batteries, battery management system (BMS), and other associated accessories as kits for different vehicles toretrofit any conventional vehicle and convert it into an electric vehicle

6. HOW ENGINEERS ARE MAKING EVS BETTER, STRONGER, AND AFFORDABLE [4]

Mechanical, chemical, electrical, and other engineers are solving problems that once made mass adoption of electric vehicles virtually impossible. According to Dalal, batteries—and their cost—isone of the biggest hurdles.

"The total amount of energy available in batteries is measured in kilowatt-hours (kWh), and the metric that is commonly used is the cost per kWh ($/kWh). If the market price is $1000 / kWh, a Tesla ModelS P100D with a 100 kWh battery will theoretically cost $100,000," explains Dalal. Thanks to advancements in battery technology, the "average (cost) is between $300-500 / kWh at the moment, which is about half of what it was less than five years ago. This is representative of EV demand andadaptation of hybrid / electric technology. "

Recent technological successes that make EVs more affordable are not just a matter of advancing knowledge, but also an engineer's ability to learn and apply that knowledge from a variety of differentengineering disciplines. Rarely is a chemical engineer just a chemical engineer, and according to Dalal, neither is a mechanical engineer.

"As a mechanical engineer, I'm finding myself doing more electrical work than mechanical," said Dalal. "Any mechanical system needs control, and that is accomplished electrically in most EV cases.If you think about an EV, how does an EV drive? With the mechanical wheels. What rotates the wheels? An electric motor that generates mechanical torque and speed. What powers the electricmotor? The battery, which supplies electrical voltage and current," and so on. "A deep understanding of both (mechanical and electrical engineering) is crucial for any student trying to get into the EVworld."
Dalal and other engineers like him are a driving force in EV success, but certainly not the only ones. After all, even the most well-designed EV is worthless without a sustainable power source to charge it.

7. RECENT TRENDS IN THE TESLA ADAPTIVE SUSPENSION (RAVEN)

I We've seen a lot of vibration analysis charts comparing the action of the old coil spring suspensionand the Smart Air Suspension on the Model S, and while the difference in ride quality is notable at
certain speeds, the two aren't vastly different. However, the new Raven Adaptive Suspension has them both beat in terms of ride comfort, with road analysis and cushioning adjustments that make potholes practically disappear. Gains in efficiency at highway speeds come from the automatic lowering of the suspension at a pre-set speed to reduce drag, and Tesla has been constantly refining this feature to get height and leveling of the suspension to best suit the driving conditions.
Coupled with Tesla's over-the-air updates, the future of this system should be one of constant improvement. One of the most helpful updates so far is the visualization of the Adaptive Suspension's compression and rebound right on the instrument cluster. Drivers can see a graphic of their vehicle's air suspension adjustments in real-time with data readouts on the Touchscreen Control Panel.
So how does the Raven Adaptive Suspension compare to previous iterations of Model X and Model S suspension? Smart Air Suspension, the suspension technology previously available as standard on the Model X and various years and trims of the Model S, allowed specific driver control over the ride height of the vehicle. The ability to take charge of the height of the vehicle was one of the big selling points of the system, and many drivers enjoyed their control of the suspension height for known problem stretches of road or better performance on the highway. Like the Adaptive Suspension, Smart Air Suspension did change height automatically based on GPS location and speed, but, unlike its
Raven counterpart, it did so without much road-sensing damping
So is the new suspension an all-around improvement? We think so: the performance of the Raven
Adaptive Suspension system in both increased efficiency and improved ride comfort speaks for itself. Further, if we compare the Adaptive Suspension to the even older coil spring suspension of the ModelS, there is no comparison in ride quality. Finally, thanks to the Adaptive Suspension's Sport setting, the Model S or Model X with the Raven upgrade can shift from a marshmallowy comfort ride to a lean, mean, corner-gripping machine with the touch of the control screen. Sport mode leaves coil
spring technology very little advantage over the Adaptive Suspension besides a reduced maintenanceand repair cost.

II Tesla Smart Air Suspension 101 – Pros, Cons & More

Along with the ability to manually adjust the height of the car through the vehicle's control panel, drivers can expect the car to save the GPS location of the vehicle for each adjustment. Tesla's SmartAir Suspension software then automatically adjusts the height of the car when it encounters a saved
data point, such as a steep driveway, a carwash, or bumpy dirt road. Note: these data points can also be delete that data afterward so that you don't have to drop to Low every time you drive up to visit.
In addition to data point adjustments, automatic height adjustments occur for different speeds to reduce drag and provide more ride stability. The speed thresholds for these adjustments have changed over the years thanks to over-the-air updates; currently, Tesla's Smart Air Suspension will reduce the height from Very High to High at 22 mph, and from High to Standard at 35 mph.
One of the reasons that a pre-2017 used Model S with a coil spring suspension might be worth digging for is that coil springs are fairly inexpensive to replace if there's a suspension issue. Air suspension, onthe other hand, can be an expensive repair project and may not be worth dealing with even on a bargain used Model S.
Fun fact for those wondering what kind of damage the bottom of a Model S could take if the
suspension is adjusted too low for the driving conditions: after getting feedback on concerns about battery safety, Tesla added a titanium shielding panel (plus a few other structural elements) to the underside of the Model S that was capable of shattering a concrete block at driving speed. It just goes to show that damage received when scraping the bottom of a Model S isn't even in the same ballpark as damage received by something like a Prius under the same conditions. Ouch.

III **Replacement of the Tesla Smart Air Suspension**

When Tesla completed the development of their new 'Raven' drivetrain, they upgraded the air
suspension to what they called Adaptive Suspension, which is now standard on the Model S and Model X as of 2019. We'll be adding a more in-depth look at Adaptive Suspension in an upcomingblog post; for now, it's enough to add that the upgrade mainly improved ride comfort, adjustability,and visual display details.
The EV Revolution Will Require More Engineers

As we have seen the various trends in particular and how this new technology will take the new face of the way we transport, there is a matter of fact which revolves around this and it is very important for the various engineers working and having specialization in different domains. All their expertise will
come to play in the development of E-Vehicles.Some future jobs are most likely to be generated in thisdomain and some of the jobs and requirements are listed below based on the category and proper
segment of work, it is divided into the type of work and skills required from a specific engineer. [2]

Chemical engineers investigate the properties, composition, and structure of matter and the laws that govern the reactions of substances to each other. Using this knowledge, chemical engineers working on electric vehicles find new chemicals to use in batteries or ways to make existing batteries work better and safer. They work closely with other engineers and scientists to develop new batteries and related technologies.

Electronics engineers design, develop, and test electronic components and systems for these vehicles.
These engineers are primarily focused on the control systems and additional electronic components for the vehicle. They don't usually focus on the generation and distribution of electricity.

Mechanical engineers design, develop, and test the tools, engines, machines, and other mechanical devices used in electric vehicles. Devices may include components of electric vehicles or machinesused in the manufacture or repair of these vehicles. These engineers may focus on engines, electric motors, or other mechanical devices, such as transmissions, drivetrains, or steering systems. In
addition, they may get involved in packaging the electronic circuits within the EV as well assupporting the design of its internal cables.

Materials engineers study various materials' structures and chemical properties to develop new products or enhance existing ones. For EVs, materials engineers are heavily involved in battery research and develop materials for other parts of the vehicle. Structural and mechanical components made out of lighter or stronger materials will be needed to make vehicles more fuel-efficient and reliable. The materials also may improve the safety of vehicles as well as their environmental impact.

8. THE CHALLENGES FOR THE EV MARKET IN INDIA

India only has 650 charging stations as per official reports in 2018

The average on-road price of electric vehicles in India is not attractive enough for consumers

EV startups and auto majors caught between reducing EV costs and spending money to boostinfrastructure.

High Price Of Electric Vehicles
Further, the average cost of electric cars in India is around INR 13 Lakh, much higher than the averageINR 5 Lakh for economical cars run on traditional fuel. Also, the price of electric scooters and motorcycles in India is between the price range of INR 70K – INR 1.25 Lakh, as compared to INR 30K – INR 40K cost range of ICE bikes and even lower for scooters.

Range Anxiety
Range anxiety is what consumers suffer from knowing that the electric vehicle might not have sufficient range to take them to their destination. This is deeply linked to the lack of charging
infrastructure in the country, and while conventional vehicles can be refueled at petrol stations, suchregularized infrastructure is not yet available for EVs.

Rudratej Singh, president, and CEO of BMW Group India, also earlier said that the infrastructure for electric vehicles is still ambiguous and uncertain, which would affect the price and acceptability of thevehicle among Indian consumers. Toyota too has recently halted the manufacturing of electric and hybrid cars for the Indian market, citing inadequate charging infrastructure.

9. CONCLUSION

The progress that the electric vehicle industry has seen in recent years is not only extremelywelcomed, but highly necessary in light of the increasing global greenhouse gas levels. As
demonstrated within the economic, social, and environmental analysis sections of this webpage, the benefits of electric vehicles far surpass the costs. The biggest obstacle to the widespread adoption of electric-powered transportation is cost-related, as gasoline and the vehicles that run on it are readily available, convenient, and less costly also in countries like India these factors play a major role in influencing the market of vehicles. As is demonstrated in our timeline, we hope that over the next decade technological advancements and policy changes will help ease the transition from traditional fuel-

powered vehicles. Additionally, the realization and success of this industry rely heavily on the global population, and we hope that through mass marketing and environmental education programs

people will feel incentivized and empowered to drive an electric-powered vehicle. However, this very technology has great potential and if the stated challenges can be minimized to some extent then in India it may bloom. This alternative has a lot to work upon to take over the existing market of vehicles in India and prove its worth in many domains such as cost and range. If through some technological

advancements this is ensured and also the charging ports for the vehicles are given thought and how they can be implemented in India, having many topographical challenges to overcome, surely this willlead to a better and sustainable green future.

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[2]EVs necessitate more engineers (a “team”) and more disciplines for their development compared to combustion-engine vehicles.
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