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"ELECTRIC VEHICLE IN INDIA AND UNDERSTANDING THE CONSUMER PERCEPTION"

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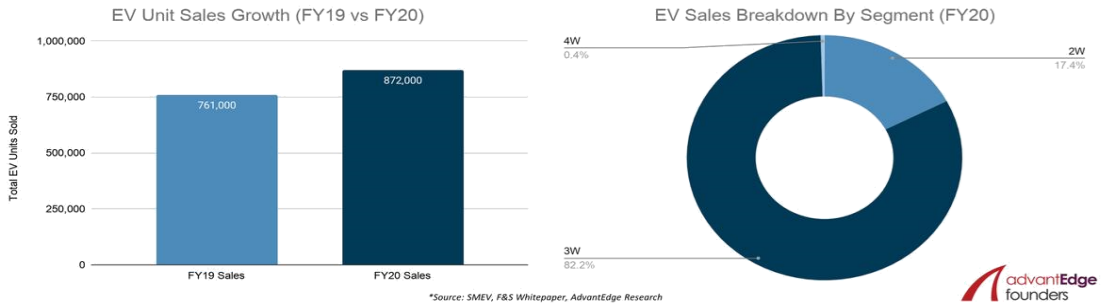
Abstract
India is a country with the third-largest road network in the world. Road travel seemed to be a preferred choice in India with over 60 % of the population used personal or shared vehicles to commute. Conventional vehicles are a major cause of global warming and environmental air pollution. All types of vehicles produce dust from brakes, tires, and road wear. The average diesel vehicle has worse effect on air quality than the average gasoline vehicle. But both gasoline and diesel vehicle pollutes more than the electric vehicle.
Governments started using fiscal policies, such as road tax, to discourage the purchase and use of more polluting cars. Green tax is imposed while re-registering the vehicle after 15 years of use to make people discontinue the use of polluting vehicles and encourage them for fuel-efficient and less polluting vehicles.
The FAME India Scheme is an incentive scheme for promotion of electric and hybrid vehicles. It aims to promote electric mobility and gives financial incentives for enhancing EV production and the creation of electric transportation infrastructure. In 2015 the Ministry of Heavy Industries and Public Enterprises launched FAME to incentivize the production and promotion of eco-friendly vehicles including EV and hybrid vehicles.

Introduction
An electric vehicle (EV) is one that operates on an electric motor, instead of an internal-combustion engine that generates power by burning a mix of fuel and gases. Therefore, such as vehicle is seen as a possible replacement for current-generation automobile, in order to address the issue of rising pollution, global warming, depleting natural resources, etc.
In India, the first concrete decision to incentivise electric vehicles was taken in 2010. According to a Rs 95-crore scheme approved by the Ministry of New and Renewable Energy (MNRE), the government announced a financial incentive for manufacturers for electric vehicles sold in India.
In 2013, India unveiled the 'National Electric Mobility Mission Plan (NEMMP) 2020' to make a major shift to electric vehicles and to address the issues of national energy security, vehicular pollution and growth of domestic manufacturing capabilities. Though the scheme was to offer subsidies and create supporting infrastructure for e-vehicles, the plan mostly remained on papers. While presenting the Union Budget for 2015-16 in Parliament, then finance minister Arun Jaitley announced faster adoption and manufacturing of electric vehicles (FAME), with an initial outlay of Rs 75 crore. The scheme was announced with an aim to offer incentives for clean-fuel technology cars to boost their sales to up to 7 million vehicles by 2020.
In February 2019, the Union Cabinet cleared a Rs 10,000-crore programme under the FAME-II scheme. This scheme came into force from April 1, 2019. The main objective of the scheme is to encourage a faster adoption of electric and hybrid vehicles by offering upfront incentives on purchase of electric vehicles and also by establishing necessary charging infrastructure for EVs.



Types of EVs
- **EVs** (also known as plug-in electric vehicles) derive all or part of their power from electricity supplied by the electric grid. They include AEVs and PHEVs.

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- **AEVs** (all-electric vehicles) are powered by one or more electric motors. They receive electricity by plugging into the grid and store it in batteries. They consume no petroleum-based fuel and produce no tailpipe emissions. AEVs include Battery Electric Vehicles (BEVs) and Fuel Cell Electric Vehicles (FCEVs).
- **PHEVs** (plug-in hybrid electric vehicles) use batteries to power an electric motor, plug into the electric grid to charge, and use a petroleum-based or alternative fuel to power the internal combustion engine. Some types of PHEVs are also called extended-range electric vehicles (EREVs).

Benefits of using an electric vehicle

1. Low Maintenance Costs

The first and foremost reason that can motivate you to buy an EV is the maintenance cost. If you buy a car with an IC engine, it will have more mechanical parts and therefore will have more complexities and difficulty in maintenance. EVs are easy and cheaper to maintain because of their simple structure and operations.

2. EVs have NO noise of their own!

Another benefit that an EV can deliver over your already existing car is the silent functioning capability. The logic is simple, there is no engine under the hood so there is no noise as well! The electric motor functions so silently that you can even read a book inside!

3. Low Running Costs

Another major advantage that EVs deliver over conventional IC engine cars is the running cost. For instance, if we look at the Hyundai Kona, it delivers around 450kms in a single charge and therefore the running costs come down to even less than a single rupee per kilometer! Amazing, isn't it?

4. No more fuel price hikes!

Do varying fuel prices trouble you? Well, if you buy an EV, you will no longer have to worry about the daily fluctuating petrol and diesel prices. While the government changes the fuel prices depending upon the global prices, you will fuel anymore if you buy an EV. You can drive in peace forever.

5. Convenient Charging at Home!

EVs have a major advantage in this case where you can simply plug in your vehicle at your home for 4-5 hours and you are ready to move again without any delay. EVs nowadays also come with fast a charging capability which allows them to juice up within 60 mins!

6. Easy to drive

All the electric vehicles starting right from an electric scooter and going all the way up to an electric bus are gearless, you only have to use a set of buttons or pedals which will make you increase or decrease the speed and that's all!

7. Environment Friendly

Buying an EV can reduce your carbon footprint because there will be no emissions at all! EVs are one of the most eco-friendly modes of transport available right now in the market.

8. Comfortable Cabin and More Storage Options

We know we have already mentioned that the cabin is silent but if you go for an EV, you will get better legroom too. Although, the front section can offer you a better storage space because the gear lever is not there, the rear section of the cabin gets you a flat floor which is why the passenger in the middle can also enjoy the ride to the fullest! The storage options also increase, there can be storage option in the front under the hood as there is no engine this time. Motors and batteries don't take much space as compared to the engine.

9. Government Incentives

Delhi Electric Vehicle Policy 2020

The benefits of buying an EV are not limited to the vehicle itself. Now, the Delhi government also wants you to buy an EV because EVs are the future! The Delhi government has recently introduced a new electric vehicle policy under which you can get additional benefits up to ₹1.5 L

10. EVs are Future Proof!

Considering where we are heading to, EVs are the only future we can look up to! The fossil fuels are about to end anytime and it is not a fair decision to exhaust all the fossil fuels while we live our life. Electricity is also generated from fossil fuels but we are slowly moving towards renewable sources of energy which is definitely the future! We have solar energy and wind energy which are renewable and do not cause pollution too! EVs are the future and we must get used to it in the present too!

Challenges with Electric vehicle

1) Driving range

The term 'range anxiety' is familiar to those who've done their research on electric cars. The current cohort of EVs are not able to do the sort of long distances that you'd get out of a fossil-fuelled car, but the distance you can travel on a single charge has improved a lot recently and continues to do so. Many of the more common electric cars can now travel 70 – 100 miles, and even more, with only one trip to the charging point. Hybrid electric vehicles can do a lot to reduce range anxiety as the electric motor works in tandem with a combustion engine. However, most trips made in a car are less than 30 miles, which most EVs are able to do without issue.

2) Recharge time

Charging electric vehicles does take longer. Estimates show that 80% of EV charges take place on a slow charge at home over night, which is sufficient for most purposes. Also, many businesses now have electric vehicle charging points in their company car parks, as we do here at Good Energy. But what about the situation I've outlined above, where you want to be able to recharge and get back on the road? Unfortunately, there is no five minute recharge for electric cars just yet. However, rapid charging is becoming more common, you'll just need to plan it into longer journeys as even a rapid charge takes 20 – 30 minutes.

3) Battery life

A battery is vital to an electric car, you certainly won't be driving anywhere without one! The batteries currently in use in EVs in the UK do have a limited life expectancy, however, and will need to be replaced every 3 – 10 years depending on the make and model. There's quite a discrepancy in those figures, - 10 years is a lot more than three, so you can already see how the technology has been improving. Battery replacement is a longer-term cost calculation that needs to be remembered when you're considering purchasing an electric vehicle.

India's position on Electric vehicle

Controlling Pollution: According to the International Council for Clean Transportation (ICCT), an estimated 74,000 premature deaths were attributable to air pollution from transportation tailpipe emissions in India in 2015. o Also, many top polluted cities in the world are from India. For example, New Delhi.

Mitigating Climate Change: In December 2019, in the Climate Risk Index 2020 released by the environment think tank, German watch, India's rank has worsened from the 14th spot in 2017 to 5th in 2018 in the global vulnerability ladder. o This makes it all the more reason for India to make electric cars and vehicles a priority in the fight against the reliance on fossil fuels.

Sustainable Energy Options: Shifting towards EVs will help India to reduce oil dependency while solving the challenge of energy scarcity and moving towards renewable and clean sources of energy.

Associated Challenges

Lack of Battery Cell Manufacturing: There is a complete absence of primary battery cell manufacturing in India which poses the risk of increasing trade deficit. At the moment, most manufacturers rely on batteries imported from Japan, China, Korea and Europe.

Building Charging Infrastructure: Another big challenge is the development of charging infrastructure which will need to be combined with existing refueling stations and at alternative locations closer to homes.

Limited Grid Capacity: According to a Niti Aayog report, India's EVs market needs a minimum of 10 GW of cells by 2022, which would need to be expanded to about 50 GW by 2025. However, currently, India is able to add only 20 GW every year to its grid for all of our other increasing energy needs. Thus, the fulfillment of the requirement of 10GW additional capacity only for EVs would be a huge task.

Local Issues: Bringing transportation decisions closer to the people is understandable and necessary. Transport challenges such as congestion, affordability, infrastructure and transit systems availability are localized issues, impede the standardization of EVs.

Current Policy of Indian Government

FAME Scheme: The Indian government has created momentum through its Faster Adoption and Manufacturing of (Hybrid &) Electric Vehicles schemes that encourage, and in some segments mandates the adoption of electric vehicles (EV), with a goal of reaching 30% EV penetration by 2030. o If these aims are realised by 2030, they will generate an estimated saving of up to 474 Millions of tonnes of oil equivalent (Mtoe) and 846 million tonnes of net CO2 emissions over their lifetime.

Fiscal Incentives: Various fiscal demand incentives have been put in place to spur the production and consumption of

EVs and charging infrastructure - such as income tax rebates, exemption from customs duties, etc.

Way Forward

Increasing R& &D in EVs: The Indian market needs encouragement for indigenous technologies that are suited for India from both strategic and economic standpoint.

- Since investment in local research and development is necessary to bring prices down, it makes sense to leverage local universities and existing industrial hubs.
- India should work with countries like the UK and synergies EV development.

Sensitising Public: Breaking away the old norms and establishing a new consumer behavior is always a challenge. Thus, a lot of sensitisation and education is needed, in order to bust several myths and promote EVs within the Indian market.

Viable Electricity Pricing: Given current electricity prices, home charging may also be an issue, if the generation is from thermal power plants run on coal.

Creating the Closed-Loop Mobility Ecosystem: Subsidizing manufacturing for an electric supply chain will certainly improve the EV development in India.

- Along with charging infrastructure, the establishment of a robust supply chain will also be needed.
- Further, recycling stations for batteries will need to recover the metals from batteries used in electrification to create the closed-loop required for the shift to electric cars to be an environmentally-sound decision.

Top Developments That Shaped the EV Sector in 2020

Indian EV Startups Continued to Attract Investments Despite COVID-19

Even in an economy affected by COVID, several Indian EV startups have managed to raise funding, which speaks to the potential that investors see in this segment. There are two key customer segments in the EV market today – one that is looking at EVs purely from a TCO (Total Cost of Ownership) perspective, and the other that see EVs as the future of automobiles and as technologically superior.

In India, the EV market has been primarily driven by the two and three-wheeler segments. That said, several automobile makers have also started introducing premium electric cars in the country in the last couple of years. India is at a unique position in the global EV landscape, offering enormous opportunities for stakeholders who are mindful of price-sensitive consumers.

After the lockdown, the consumers are likely to be more inclined towards using personal vehicles for the commute as the new normal now includes optimum hygiene and social distancing. This could be an opportunity to be leveraged by the EV segment. And for that, the stakeholders and the government should unite to form a solid roadmap for growth.

Domestic Manufacturing Push for EV Components

May 2020, the Ministry of Heavy Industries and Public Enterprises (MHIPE) issued a notification to all the testing agencies under Faster Adoption and Manufacturing of Electric Vehicles in India (FAME II). The notification covers the eligibility under the revised Phased Manufacturing Program (PMP) for xEV (generic name for electromotive vehicles such as hybrid electric vehicles, plug-in hybrid electric vehicles, and fuel-cell electric vehicles) parts.

PMP will be valid for five years until 2024 and promotes domestic production across the EV value chain.

Sale of Electric Vehicles without Pre-fitted Batteries

In August, the Ministry of Road Transport and Highway (MORTH) announced that all the states and union territories are allowed to register and sell EVs without pre-fitted batteries. The move was intended to boost the wider adoption of EVs across the country.

FAME-II Program for EVs Gets New Extension

The government also extended the validity of the FAME-II program for all approved electric vehicle models by three months up to December 31, 2020. The extension comes to effect from October 1, 2020. All approved vehicle models would need to be re-validated by December 31, 2020. The program is the expanded version of FAME India I, launched on April 1, 2015, with a total outlay of ₹8.95 billion ($126.2 million).

Government Readies Incentives for 7,000 E-Buses, 55,000 E-Cars, 1 Million Two-Wheelers

In September, Union Heavy Industries and Public Enterprises Minister, Prakash Javadekar, said in Lok Sabha that the Centre had provided a demand incentive of ₹950 million (~$12.9 million) towards 27,201 EVs until September 10, 2020. The demand incentives will cover 7,000 electric buses, 55,000 electric cars, and one million electric two wheelers under FAME-II. Javadekar added that 5,595 electric buses had been approved for several states and city transport undertakings under the FAME II program, including a government incentive of ₹28 billion (~$380.5 million).

Delhi, Telangana Exempt Road Tax for EVs

The Delhi Government exempted road tax on all battery electric vehicles. The transport department issued a notification saying that the Delhi government has exempted the tax on all battery electric vehicles with immediate effect in the region under the Delhi Motor Vehicle Taxation Act, 1962. In August 2020, the government introduced the Delhi Electric Vehicle Policy 2020 to enhance EV adoption in the national capital region. The new policy proposed tax waivers, charging and swapping infrastructure establishment, battery cycling ecosystem, and creating a non-lapsable State EV Fund.

The government also offered financial incentives for EV buyers in the region. Under the policy, erickshaws, electric two-wheelers, and goods carriers will receive incentives of ₹30,000 (~$408.09). Simultaneously, purchasers of electric cars will receive incentives ranging from ₹10,000 (~$ 136.03) to ₹150,000 ($ 2040.47). It also planned to boost the adoption of battery electric vehicles, contributing to 25% of all new vehicle registrations by 2024. The government plans to pay the subsidies within two days to eligible EV buyers in Delhi through a software developed by the ICICI Bank.

The Government of Telangana also released its new Electric Vehicle and Energy Storage Policy for 2020- 2030, announcing subsidies, policy measures, and other incentives to turn the state into an EV and energy storage system development and manufacturing hub. The new policy will be applicable for ten years and provides a framework to boost EV adoption, charging infrastructure development, and component manufacturing in the state. Under the policy, the first 200,000 electric two-wheelers, 20,000 electric three-wheelers, 5,000 electric four-wheel commercial passenger vehicles, 10,000 electric three-wheel goods e-carriers, 5,000 private electric four-wheelers, 500 electric buses, and electric tractors would be eligible for a 100% exemption on road taxes and registration fees.

RESEARCH METHODOLOGY

Marketing Research is the function which links the consumers with the marketers to identify and define market opportunities, taking suitable actions and understanding the consumer behavior defining the external and internal risks. The information is being collected and the collected information is being analyzed for getting better results in future. There are many ways of tackling the problem. The main purpose behind the study was to meet the wants and needs of the consumer and provide valuable information regarding the impact of electric vehicles.

Types of Data: There are two types (sources) for the collection of data.
(1) Primary Data
(2) Secondary Data

Primary Data: The primary data are the first-hand information collected, compiled and published by organization for some purpose. They are most original data in character and have not undergone any sort of statistical treatment. Example: Population census reports are primary data because these are collected, complied and published by the population census organization.

Secondary Data: The secondary data are the second-hand information which are already collected by someone (organization) for some purpose and are available for the present study. The secondary data are not pure in character and have undergone some treatment at least once.

Sample size: The Sample Size for this research is 212.

Sampling technique: For selecting required respondents simple random sampling technique was used. Chi square test is used to test the hypothesis.

DATA ANALYSIS AND INTERPRETATION

1. **Demographics of the survey:** The sample size is 212 out of which 60.4% are male and 39.6% are female. 7.5% of respondents fall under age group of 18-23 yrs, 55.7% in 24-40 yrs, 27.8% in 41-55 yrs and 9% are 56 yrs & above.

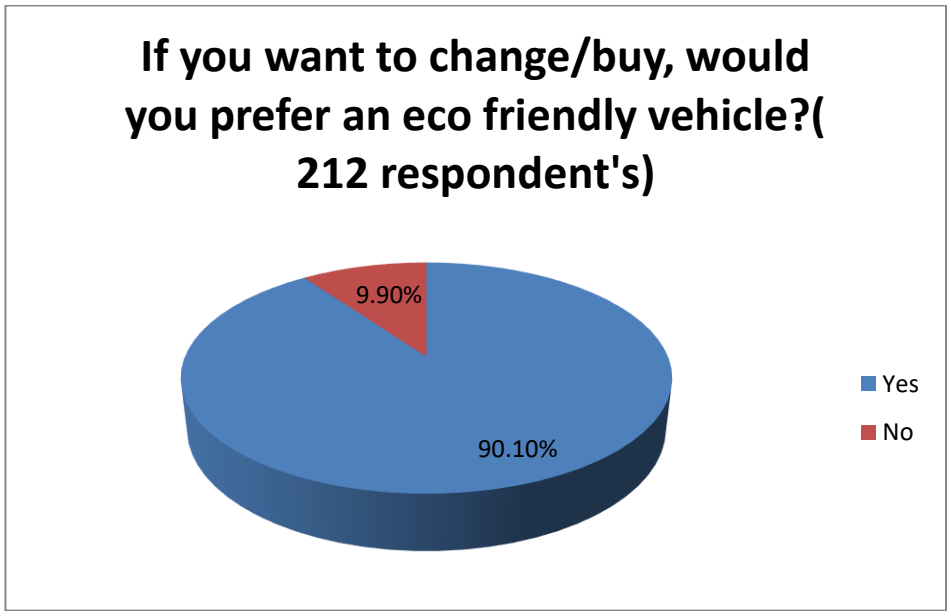
Table 1: Showing number of males and females who took the survey

Number of respondents	212
Male	128
Female	84

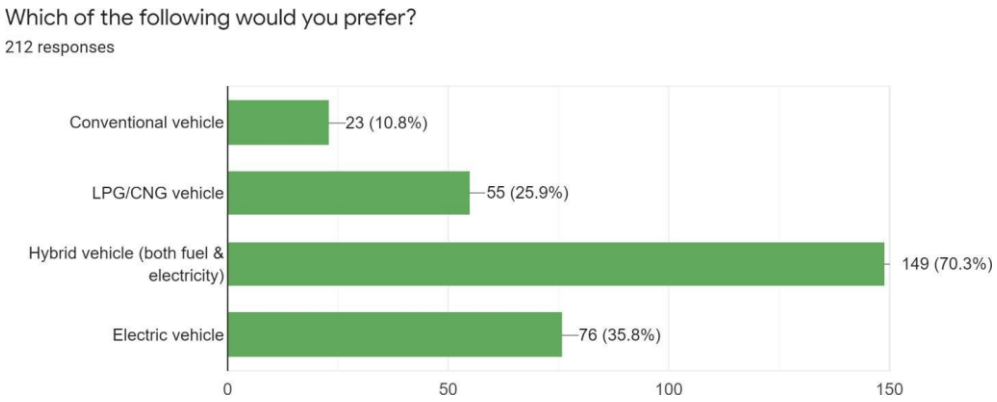
Table 2: Showing age of the respondent

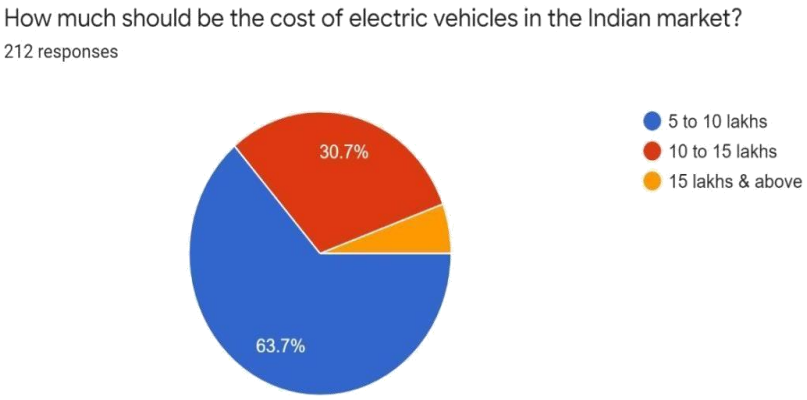
Age	No. of Respondent	Percentage
18-22	16	7.5
22-30	118	55.7
30-45	59	27.8
45 & Above	19	9

2. **How many prefer eco-friendly vehicle:** 191 were in favor of eco-friendly vehicles and 21 favored conventional vehicle. Respondents are aware of climate conditions and ready to change their preference to eco-friendly cars.



3. **When asked regarding choice of vehicle, respondents majorly selected hybrid vehicles.**



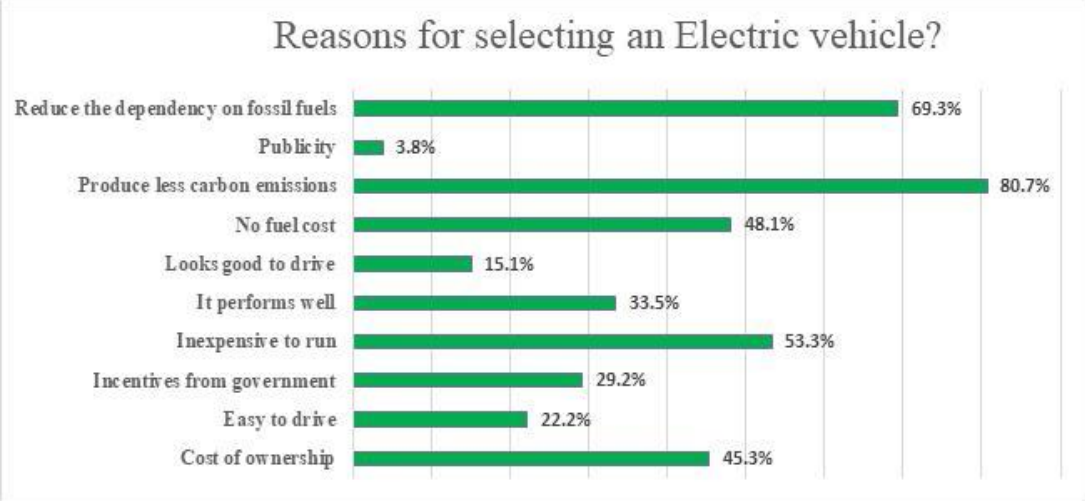


4. **How much would they be willing to pay for EV: C**ost being an important factor, customer expects EVs in 5-10 lakhs range.

Price (Lakhs Rs.)	No. of Respondents
3-10	135
10-15	65
15-above	12

5. Reasons for selecting an Electric vehicle

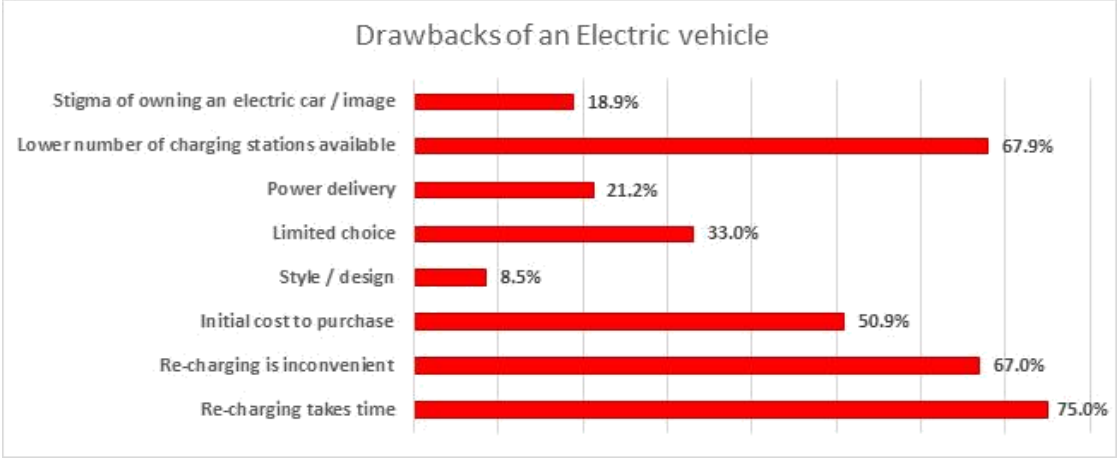
Reasons for selecting an Electric vehicle	Number of respondents	Percentage %
Reduce the dependence on fossil fuel	147	69.3
Publicity	8	3.8
Produce less carbon emission	171	80.7
No fuel cost	102	48.1
Looks good to drive	32	15.1
Performs well	71	33.5
Inexpensive to run	113	53.3
Incentive from government	62	29.2
Easy to drive	47	22.2
Low cost of ownership	96	45.3



To find the consumer perception selecting it's EV. The respondent important considers less carbon emissions, less dependency on fossil fuels, inexpensive to run as important factors.

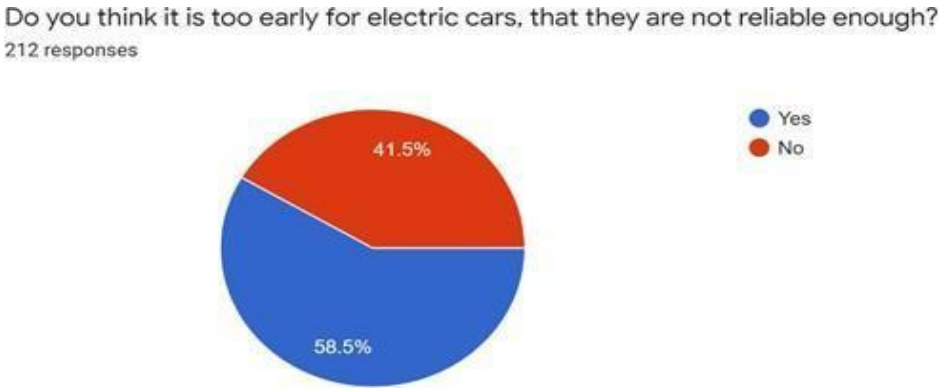
6. Drawbacks of electric vehicle

Reasons for selecting an Electric vehicle	Number of respondents	Percentage %
Stigma of owning an electric car/image	**40**	**18.9**
Lower number of charging stations available	**144**	**67.9**
Power delivery	**45**	**21.2**
Limited choice	**70**	**33**
Style/design	**18**	**8,5**
Initial cost to purchase	**108**	**50.9**
Re-charging investment	**142**	**67**
Re-charging takes time	**159**	**75**

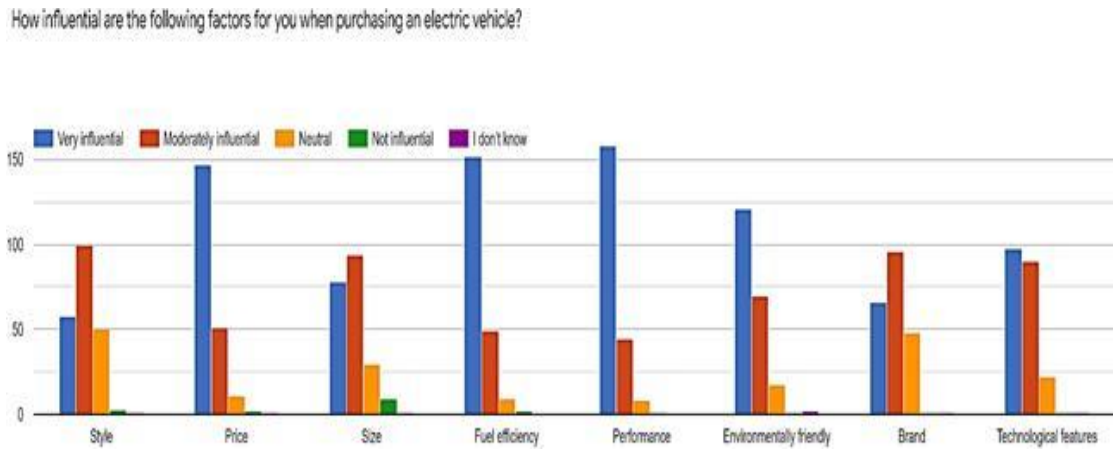


Respondents considers recharging time, limited charging stations, difficulty in charging as major Drawback/limitation to consider EVs in current situation.

7. Do you think it is too early for electric cars, that they are not reliable enough?
Considering the current infrastructure and development of electric vehicle in India, majority of respondents considers that it is early for EVs to launch.



8. Respondents were being asked about the various factors which influences the purchase decision of a vehicle.
Majority of respondents consider performance, fuel efficiency, price, technical features and environment friendly as very influential, whereas they consider style, size and brand as moderately influential factors.



Hypothesis Testing
Test 1: Relationship between Choice of vehicle and Gender
H0: There is no difference of gender on the choice of vehicle.
H1: There is significant difference of gender on the choice of vehicle.

Actual					
Count of vehicle	**Column Labels**				
Row Labels	**Conventional**	**LPG/CNG**	**Hybrid**	**Electric**	**Grand Total**
Male	**19**	**18**	**73**	**18**	**128**
Female	**4**	**32**	**38**	**10**	**84**
Grand Total	**23**	**50**	**111**	**28**	**212**

Expected					
Count of vehicle	**Column Labels**				
Row Labels	**Conventional**	**LPG/CNG**	**Hybrid**	**Electric**	**Grand Total**
Male	**13.88679245**	**30.18867925**	**67.01886792**	**16.9056603**	**128**
Female	**9.113207547**	**19.81132075**	**43.98113208**	**11.0943396**	**84**
Grand Total	**23**	**50**	**111**	**28**	**212**

P Value 0.000315703

P value is smaller than 0.05 thus we reject H0 & accept H1 i.e. there is significant difference of gender on the choice of vehicle.

Test 2: Relationship between choice of vehicle and Income
H0: There is no significant difference in income group of people and their choice of vehicle.
H1: There is significant difference in income group of people and their choice of vehicle.

Actual					
Count of vehicle	Column Labels				
Row Labels	Conventional	LPG/CNG	Hybrid	Electric	Grand Total
up to 5 Lakhs	7	16	33	12	68
5 to 10 Lakhs	6	21	36	6	69
10 to 20 Lakhs	7	7	22	7	43
20 Lakhs & above	3	6	20	3	32
Grand Total	23	50	111	28	212

Actual					
Count of vehicle	Column Labels				
Row Labels	Conventional	LPG/CNG	Hybrid	Electric	Grand Total
up to 5 Lakhs	7.377358491	16.03773585	35.60377358	8.98113207 68	68
5 to 10 Lakhs	7.485849057	16.27358491	36.12735849	9.11320754	69
10 to 20 Lakhs	4.66509434	10.14150943	22.51415094	5.67924528	43
20 Lakhs & above	3.471698113	7.547169811	16.75471698	4.22641509	32
Grand Total	23	50	111	28	212

Pvalue
0.556199434

P value is greater than 0.05, we do not reject H0, but this does not necessarily imply that we should accept H0. We can conclude that H0 is true or false but our experiment and statistical test were not "strong" enough to lead to a p-value lower than 0.05.

7. CONCLUSION

With the depletion of fossil fuels and constant hike in fuel prices, there is a need for energy transition in vehicles in India. Govt has taken initiative to fight pollution levels by promoting EVs and giving subsidies on purchase. To boost its production, Govt has eased the FDI norms. Various emerging brands are launching EVs in India. The Government and manufacturers should join their hands to build the infrastructure and create positive environment for EVs.
The respondents are aware of global climate conditions and are ready to change their preference from conventional to eco-friendly vehicles. Cost is an important factor while considering the purchase of EV.
Respondents are willing to consider EVs as their future purchase option, if proper infrastructure is available. Initial cost of purchase, less number of charging stations and the time required to recharge the battery is creating limitation in boosting consumer confidence.

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