

## A case study on the perception of consumers of Bhubaneswar towards electric vehicles

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**Abstract:** Electric vehicle (EV) is the solution for reducing greenhouse effect with the improvements in the areas of power electrics, energy storage & support. The plug in hybrid electric vehicle (PHEV) provides competitive driving range & fuel economy compared to internal combustion engine. An overview of the present status & future trends in electric vehicle technology is provided. The emphasis is on the impact of rapid development of electric motors, power electronics, microelectronics & new materials. Comparisons have made various electric drive systems, battery systems & super capacitor technology as a possibility to increase the energy capacity of PHEV. The market size of electric vehicles in future & potential electric vehicle impacts are discussed.

**Key Words:** EVs, PHEVs, energy transmission, battery technology.

### 1. INTRODUCTION:

The potential customer has mostly affected the dynamic (volatile) oil pricing. The issues of climate change have been rigorously discussed by many governments which is dominantly driven by human activities (like burning of fossil fuels, industrialization). Electric car is one powered by an electric motor rather than a traditional petrol/diesel engine. Government incentives to increase adoptions were introduced including in the United States & the European Union. The ever growing transportation sector consumes about 49% of oil resources. The world's oil resources are predicted to be depleted by 2038. Therefore, it is mandatory to replace non-renewable energy sources with renewable energy sources & use of suitable energy saving technologies. To overcome that, the attractive features of electric vehicles mainly are the power source & drive system.

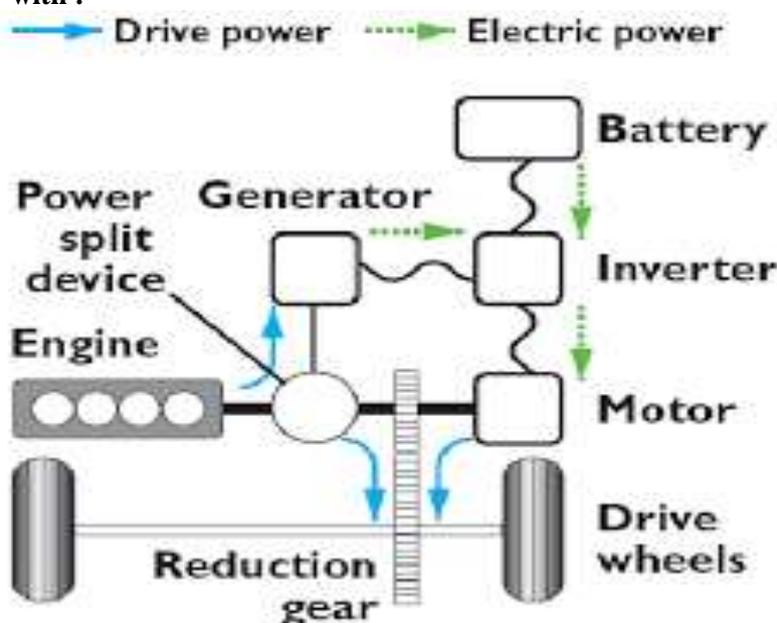
Electric vehicle ecosystem in India continues to be at a very nascent stage. However, the central government has already announced the second phase of its ambitious FAME (faster adoption & manufacturing of electric (hybrid) vehicles) policy & aims to set up EV adoption in the country across segments. Here is a list of top 10 EV manufacturers in the country.

1. Hero electric
2. Tata motors
3. Ather energy
4. Mahindra electric
5. TwentyTwo Motors
6. BYD olectra
7. Lohia auto
8. Hyundai kona electric
9. Ashok Leyland
10. MG motor

Conventional vehicles offering long drive range, good performance and easy refueling. Hence they are dominating the vehicle market. However conventional vehicles have limitations such as air pollution and inefficient usages of fossil fuel. Necessity of the hour is fuel efficient and low emission vehicle without sacrificing the performance, reliability and safety of the vehicle. Pollution problem can be minimized by using zero emission electrical vehicles (EV) at the cost of limited drive range. Reduction in Green House Gas (GHG) emissions, increase in oil prices, and dependency on foreign oil are major incentives to the development and deployment of Hybrid Electric Vehicles (HEV) and Plug-in Hybrid Electric Vehicles (PHEV). Compared with conventional vehicles, HEV and PHEV generate considerably low noise, green house gas and ozone-precursor emissions. However, unlike HEV, PHEV offers the vehicle owner the flexibility of charging the onboard battery. Therefore, it allows the combustion engine to operate within its optimal efficiency range for longer periods which in return would increase fuel savings. A battery is capable of storing large amounts of energy (in order of 100Wh/kg), but is not suitable for supplying a large amount of power in a very

short time due to a low power output density. HEVs can significantly improve fuel economy and reduce emissions with the satisfaction of vehicle performance. Typical HEVs consist of an internal combustion engine (ICE), electric motor (EM), single or multiple energy storage systems (ESS), power electronic converters, and controllers. The behavior of robust controller in the field of electric machine and the result which augurs us to adopt the fuzzy controller in the system. Over the past few decades, the use of fuzzy set theory, or fuzzy logic, in control systems has gained widespread popularity, all over the world. It is therefore easier to be designed and more suitable to the control of the drives. Since petroleum is limited and will someday run out of supply. In the arbitrary year 2037, an estimated one billion petroleum-fueled vehicles will be on the world's roads, gasoline will become prohibitively expensive. Hybrid vehicle drivetrains transmit power for hybrid vehicles. A hybrid vehicle has multiple forms of motive power. One of the earliest forms of hybrid land vehicle is the 'trackless' trolleybus of the 1930s, which normally used traction current delivered by wire. The trolleybus was commonly fitted with an internal combustion engine (ICE) either to directly power the bus or to independently generate electricity. This enabled the vehicle to maneuver around obstacles and broken overhead transmission wires. The powertrain includes all of the components used to transform stored potential energy. Powertrains may either use chemical, solar, nuclear or kinetic or make them useful for propulsion. Hybrid powertrains come in many configurations.

### Structure of Electric Car with :



Like any transformative new technology, electric vehicles create a variety of potential economic development challenges and opportunities. While the electric vehicle market is still at a relatively early stage of development, it is poised to reshape industries.



Moreover, it is costlier to operate the conventional vehicles than the electric vehicles. Drivers who own and operate electric vehicles can have more savings to invest in other sectors of the economy, such as housing and services. Although electric vehicles and conventional vehicles share some of the same component parts, there are over a dozen new systems used for PEVs that are not compatible with conventional vehicles. Some of these new systems include new gear boxes, electric power steering, and water pumps to cool the electric engine. Battery packs, cell components, and basic materials for batteries will also require supply chains to be refigured.

Electric Vehicles: Hurdles to Development and Solutions

High cost of PEVs Limited charging Infrastructure Consumer misperceptions-

### Demand Side Strategies

- Provide tax incentives for purchase
- Alleviate battery ownership risk
- Provide non-financial incentives
- Encourage utility rate discounts
- Transition government fleets to PEVs
- Encourage PEV cabs

### Supply Side Strategies

- Make public investments in R&D
- Create tailored workforce training programs
- Provide business financing
- Support supply chain development
- Invest in chargers in public spaces
- Provide incentives for installing chargers
- Collaborate with private charging station providers
- Streamline local zoning and permitting
- Disseminate information on charger locations
- Develop a consumer education plan
- Establish public demonstration of PEVs
- Market private sector solutions and advancements



Hybrid Electric Vehicle (HEV)-

This is the most commonly adapted hybrid vehicle. It combines the propulsion system of an electric motor and an I.C. engine. The power supply to the electric motor comes from the onboard batteries. In a HEV, the I.C. engine combines with an electric motor which leads to a more optimal use of the engine. Driving in city traffic involves frequent starts and stops of the vehicle. During idling, the engine consumes more fuel without producing useful work thus contributing to higher fuel consumption, less efficiency and unnecessary emission from exhaust. The HEV solves the problem by switching to power transmission through the motor and shutting off the engine. This way no fuel will be consumed during idling with no exhaust emission. Another major advantage of HEV is that when fuel tank gets empty while driving the engine, the vehicle can be driven on electric power within its maximum range.

## 2. LITRETURE REVIEW:

**Satti Swami Reddy, Kola Siva Tharun(2013)** have found that co2 emissions are the primary cause of global warming and hybrid vehicles are the answers for the prevention of pollution in the atmosphere.

**Arora, S., Shen, W. and Kapoor, A. (2016)** have illustrated in their study that certain important mechanical features can be integrated while designing the battery which in turn can reduce the failure of Li-ion battery and improve some of the additional safety features.

**Burke, A. (2000)** in his exploration found out that micro porous carbons are very much used in carbon electrodes and organic electrolytes, which are fabricated for ultracapacitors, an important component in the engine of electric vehicles.

**Chakraborty, A. (2011)** has opined that renewable source of energy is very much important and it plays an important role in transmission of this energy to various forms by using different power electronic equipment.

**OLUBAYO MOSES BABATUNDE1, JOSIAH LANGE MUNDA1, ANDYSKANDAR HAMAM. (2020)** have found out in their research that because of lack of electrification in the Sub-Saharan Africa, there is a growing demand of these hybrid motors among the household consumers for water pumping, lighting, powering refrigerators for storing vaccines etc.

**Allcott, H. and N. Wozny. (2014)** have inferred in their research that fuel price and vehicle markets are dependent on each other. More of consumers have become very sensitive to fuel price and this is a great opportunity for the hybrid or electric vehicle companies.

**TekTjing Lie, Krishnamachar Prasad, Ning Ding. (2017)** have illustrated in their research that electric vehicles are very efficient as far as fuel economy, power electrics, energy storage and greenhouse effect is concerned.

**Monica B Ashok(2019)** has suggested in her research that an important aspect of protection of environment is sustainability. She also opined that in order to raise an awareness among the people for using more and more environment friendly vehicles, Govt should give more and more subsidy.

**Adepetu, A. Keshav, S.(2017)** have found out in their research that the consumers are little bit skeptical about the price of these fuel efficient vehicles and the adoption of such vehicles may be slow.

## 3. OBJECTIVE:

The objectives of the study is -

- To evaluate the awareness levels of consumers on E-Vehicles
- To study the factors that influence customers to Purchase E-Vehicles

### 3.1 HYPOTHESIS-

H0 : There is no association between the awareness levels of consumers and their attitude to purchase EV

## 4. RESEARCH METHODOLOGY:

The study is conducted in the city of Bhubaneswar in Odisha. The respondents are either using EV or they are prospective customers. The sample size is taken as 90. A convenient sampling method is used to select the respondents. Data collection is done through questionnaire method and interview method. Secondary data are collected from various journals, Govt. websites, magazines and articles. Descriptive statistics, charts and graphs and chi-square are some of the statistical techniques that is used for analyzing the data.

5. ANALYSIS AND INTERPRETATION:

Table 1 - Number of years of experience

	0-2	2-4	Above 4
Male	21	29	10
Female	11	13	6

Chart 1 - Number of years of experience

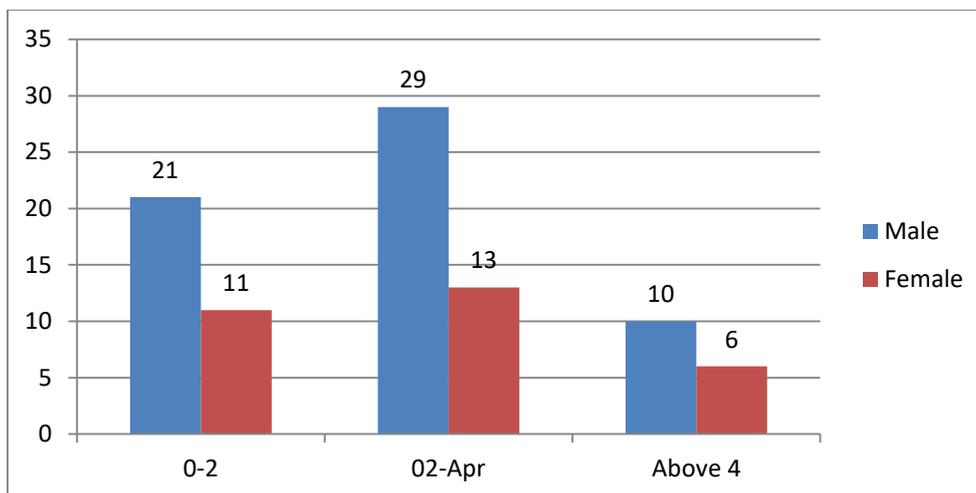


Table 1 shows the number of years of experience of driving E-vehicles on the basis of gender. There is a maximum of 29 male respondents and 13 female respondents who have an experience of 2-4 years of driving E-vehicles. Chart-1 shows male respondents are maximum users of E-vehicles as compared to female respondents.

Table 2 - Educational Qualification

	Diploma	Under Graduate	Graduate	Above Graduate
Male	13	15	22	10
Female	7	4	11	8

Chart 2- Educational Qualification

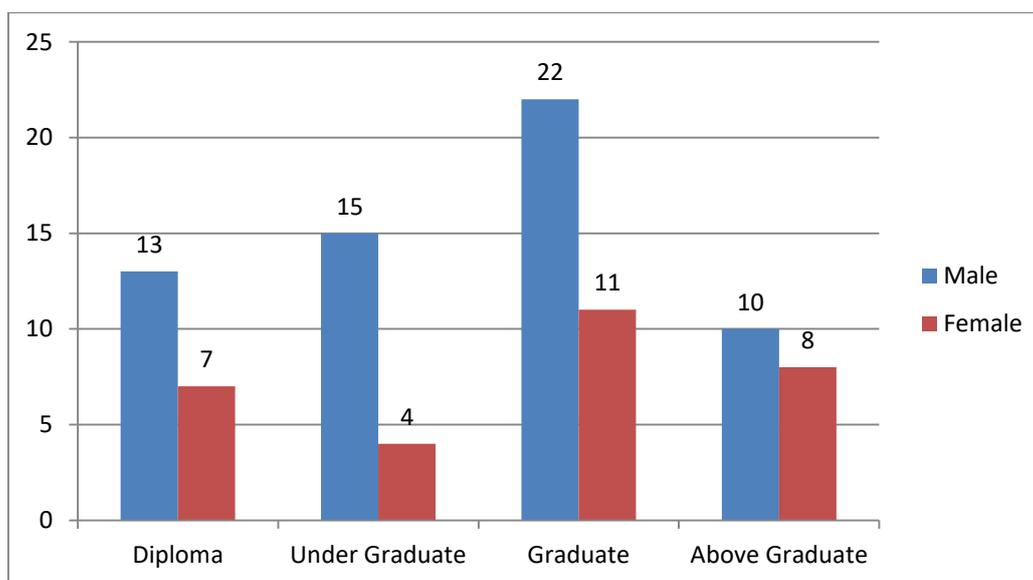


Table 2 shows educational qualification of the respondents on the basis of gender. There is a maximum of 22 male respondents and 11 female respondents who are graduates. Chart-2 shows maximum male respondents who have participated in the study are qualified. Maximum female respondents are also qualified. They are graduate and above.

Table 3 - Designation

	Senior Managers	Team Leaders	Level II Executive	Level III Executive
Male	14	13	21	12
Female	4	5	10	11

Chart 3 - Designation

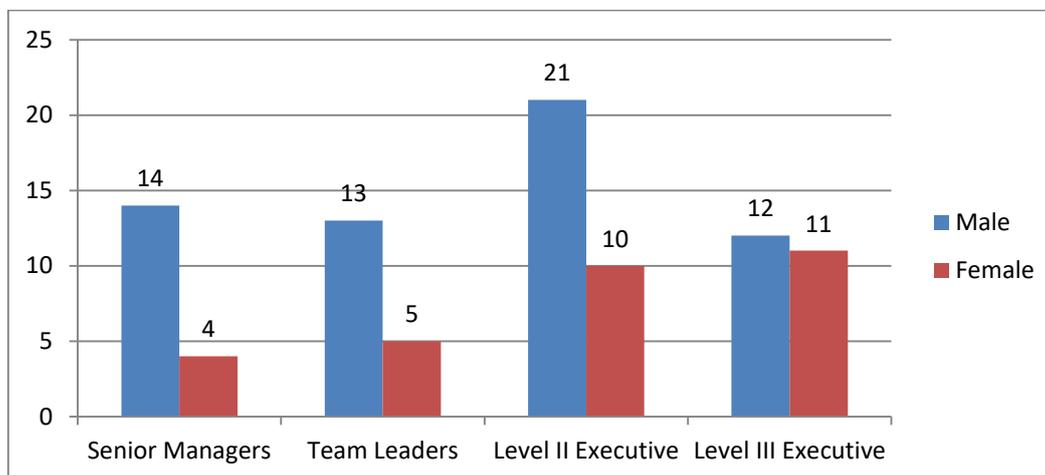


Table 3 shows designation of the respondents on the basis of gender. There is a maximum of 21 male respondents and 11 female respondents who are level II executives and level III executives respectively. Chart-3 shows maximum male respondents who have participated in the study are in good positions in their job.

Table 4 - Type of Vehicles

2 Wheelers	55
4 Wheelers	35

Chart 4 - Type of Vehicles

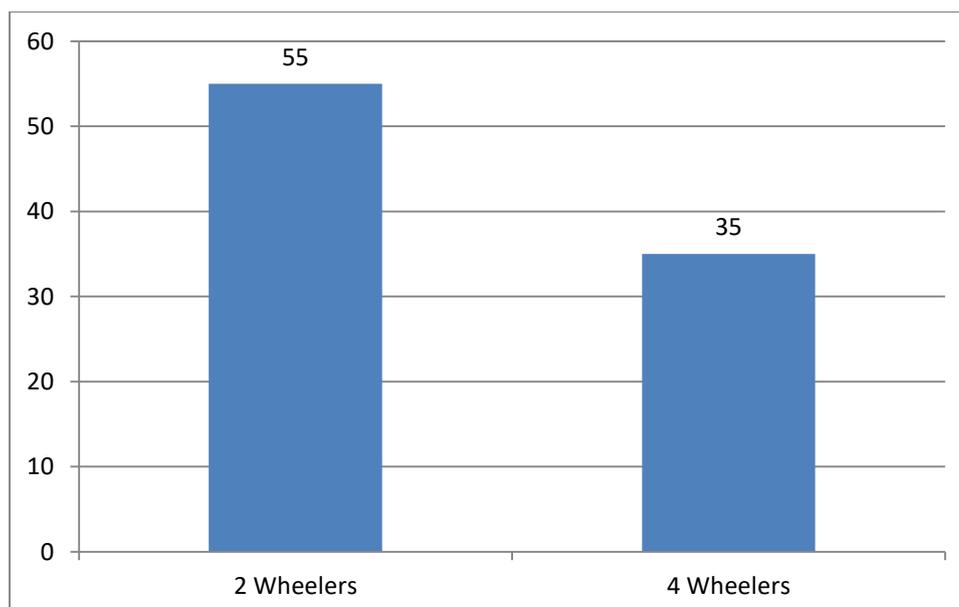


Table 4 shows types of vehicles driven by the respondents. Maximum of 55 respondents drive two wheelers whereas 35 respondents drive 4 wheelers. Chart-4 shows the same. There is a scope for the companies to bring in E-two wheelers in Bhubaneswar market as compared to four wheelers.

Table 5 - Fuel used by Vehicles

Petrol	62
Diesel	17
Electric	11

Chart 5 - Fuel used by Vehicles

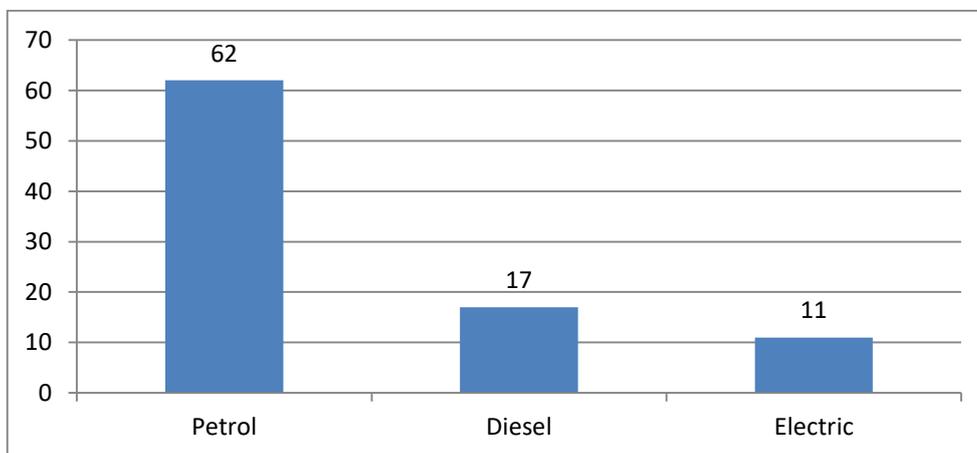


Table 5 shows fuels used by vehicles driven by the respondents. Maximum of 62 respondents drive vehicles fueled by petrol whereas 11 respondents drive E-vehicles. Chart-5 shows the same. 11 E-vehicles include 2 wheelers and 4 wheelers both. However in Bhubaneswar use of four wheeler E-vehicles is very less. In our study we got only two E-four wheelers.

Table 6 - Expenses of fuel per month

1000-3000	50
3001-5000	27
Above 5000	13

Chart 6 - Expenses of fuel per month

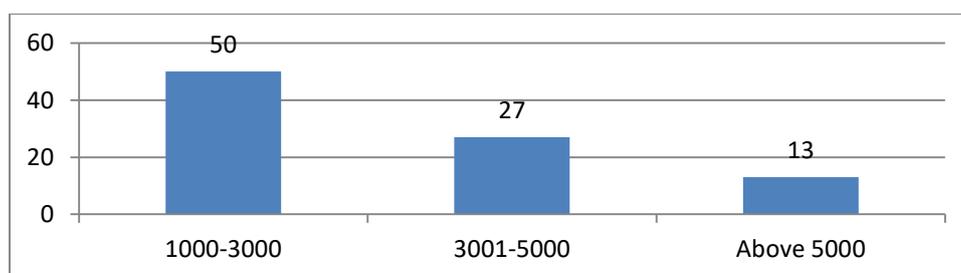


Table 6 shows fuel expenses per month by the respondents. Maximum of 50 respondents have an expenses of Rs. 1000 – 3000 per month. Only 13 respondents have expenses of above Rs.5000. It is very well represented in Chart-6 with a bar graph.

Table 7 - Awareness of Electric Vehicles

Factors	Agree	Neutral	Disagree	Mean scores
E-Vehicles are environment friendly	72	12	6	2.73
I am conscious about environment, so I prefer E-vehicle	60	22	8	2.57
There are a lot of benefits of owning a E-vehicle	52	21	17	2.38
E-vehicles solve the purpose with growing population and pollution	53	19	18	2.38
Govt. is also taking a lot of initiative for E-vehicles	41	15	34	2.07
I would buy an E-vehicle in near future	56	11	23	2.36
A hybrid vehicle is more preferred than E-vehicle	34	25	31	2.03

E-vehicle is risky due to lack of infrastructure	51	21	18	2.36
E-vehicles are not reliable for long distance travel	41	20	29	2.13
E-vehicles are economical than any other	40	25	25	2.16

Chart 7 - Awareness of Electric Vehicles

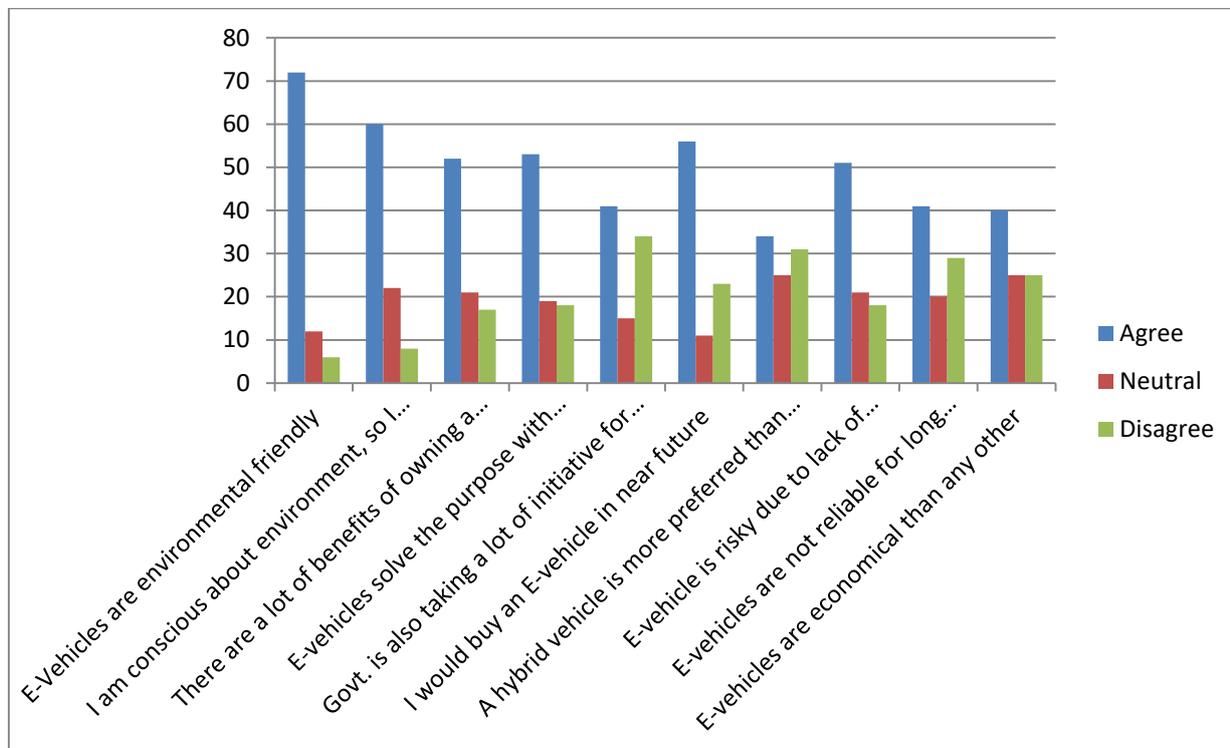


Table 7 shows awareness level of the respondents about various aspects of E-vehicles on a scale of 3. Agree(3), Neutral (2) and Disagree (1). The mean scores are also mentioned in the above table. Though the mean scores in each and every aspect is more than 2, still there is lack of awareness on many of the aspects which is need to be improved. Probably that is the reason we found very less number of E-vehicles in our study. From chart-7 it can be seen that there are many aspects on which the number of respondents who disagree is quite visible.

Table 8 - Observed values of chi-square test

		Awareness		
		Aware	Not aware	Total
Purchase intention	Agree	45	11	56
	Neutral	5	6	11
	Disagree	11	12	23
	Total	61	29	90

Table 8 shows the observed values of a chi-square test which is conducted to know the association between awareness level of E-vehicles and purchase intention. Respondents are categorized on the basis of awareness on every aspect of E-vehicles. So, there are two categories taken Aware and not aware. Attitude towards purchasing E-vehicles categorized into Agree, Neutral and disagree. Data collected from all 90 respondents.

Table 9 - Expected values and p-value of chi-square test

		Awareness	
		Aware	Not aware
Purchase intention	Agree	37.95555556	18.04444444
	Neutral	7.455555556	3.544444444
	Disagree	15.58888889	7.411111111
p value	0.004608		

Table-9 shows the expected values for the chi-square test along with the p value. The p value that is received here is 0.004608, which is less than 0.05. That means the difference between observed and expected values is significant here. Hence the null hypothesis is rejected. So it is concluded that there is an association between the awareness level and attitude towards purchase of E-vehicles.

## 6. CONCLUSION:

Hybrid-electric vehicles (HEVs) combine the benefits of both IC engines and electric motors and can be configured to obtain different objectives, such as improved fuel economy, increased power, or additional auxiliary power for electronic devices and power tools. The transmission of power using freewheels and chain wheels are very cheap and reliable. One disadvantage is that driving on electric power is not a good option for a long distance travel. Though this combined power train system can become much useful in more stop and go traffic situations. With the use of this power train system, the overall fuel consumption and fuel economy is improved. Such vehicle would run on fuel but would use its electric motor to boost the power when needed. The costs of HEVs are a little more than the conventional cars but they are more efficient and the exhaust emissions are less. In Bhubaneswar the awareness regarding HEV needs to be improved. There are very negligible users of E-four wheelers. There are few numbers of E-two wheeler users. It is found from the study that if the awareness level can be improved then attitude towards purchase of HEV will also be improved.

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