

## **CONSUMER PERCEPTION ON ELECTRIC VEHICLES: A CASE STUDY OF DEHRADUN AND LUCKNOW**

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### **Abstract**

For this study, a consumer perception structural model was prepared to know the perception level of consumers. Four points were considered: environmental concerns, driving range, vehicle prices, and infrastructure facilities. The study collected primary data from Dehradun and Lucknow vehicle owners through a structured questionnaire. The collected data were analyzed with the help of SPSS software and M.S. Excel. A consumer perception regression model was prepared to investigate consumer perceptions of vehicles. It was observed from the Consumer Perception Regression Model that the vehicle's driving range (x3) and the infrastructure facility for the vehicle (x4) variables were found to be positively related to consumer perception towards electric vehicles. On the other hand, explaining the relationship between the independent variable of environmental concern(x1) and the price of electric vehicles (x2) was also necessary, which is negatively associated with the consumer perception level in the prevailing situation. It may be concluded from the results that the interest in using electric vehicles is increasing among vehicle users and shifting their desire to have electric vehicles. The population in survey areas is very much conscious about a clean environment and better health issues. There is a bright future in the market for

electric vehicles, and they are contributing a significant role in reducing carbon dioxide levels and air pollution. The electric vehicle is a better option than fuel-based vehicles to protect the environment and the health of human beings on earth.

It may be concluded that the consumer perception towards electric vehicles depends on various factors, such as whether those are favourable or not favourable for electric cars. Where consumers live and have favourable or non-favourable conditions for electric vehicles.

**Keywords:** Consumer perception, Electric Vehicle, Environmental Concern, Driving Range, Price of Vehicles, Infrastructure Facility

## **Introduction**

Consumer Perception is consumers' opinions, feelings, and beliefs about the brand. It is essential in building customer loyalty, retention, brand reputation, and awareness. Under consumer perception, four points are taken into account. To measure the Perception level of the consumer towards electric and non-electric vehicles.

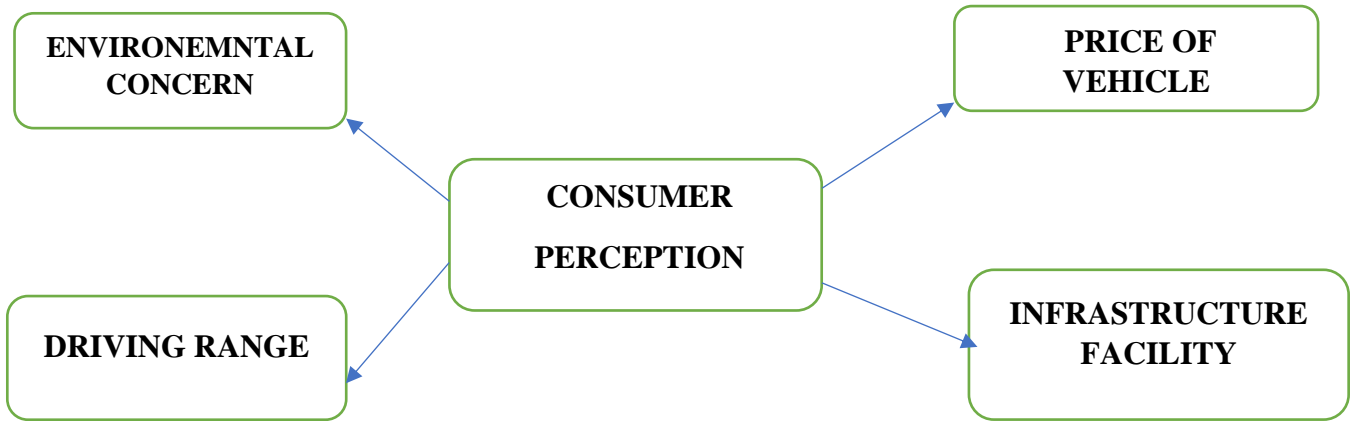
Environmental Concern: The environment can be a total of all the living and non-living elements, and their effect influences human life and their surroundings. The living or biotic elements are animals, plants, forests, fisheries, and birds; non-living or abiotic elements include water, land, sunlight, rock, and air. Environment refers to the surroundings in which life exists on Earth. Components like animals, human beings, sunlight, water, trees and air, temperature, and wind make up the environment. They are Earth's living and non-living components. Living organisms, including trees, humans, and animals, are closely related to consumer views/perceptions.

Price of Vehicles: The value of vehicles fixed by the company or agency for disposal to the purchaser.

Driving Range: The driving range of the vehicles is the crucial parameter that attracts consumer interest in purchasing the vehicles. This includes the mileage of the vehicles covered in 1 litre of fuel, whether vehicles are electric engines or other than this.

Infrastructure Facility: Infrastructure Facility directly affects the purchaser's perception of consumers towards the vehicles. This includes the type of road, charging points and quality of electric vehicle batteries.

**STRUCTURAL MODEL OF CONSUMER PERCEPTION**



**Review of Literature**

**Naor M & et al. (2015)**, this paper is explored how a company developed an environmentally friendly innovation that attempted to address diffusion issues. The purpose is to describe the ways an electric vehicles (EV) infrastructure company, in partnership with a major car manufacturer. The author tried to address barriers to the diffusion of an environmentally friendly innovation during the development stage and improve the likelihood of success and lessons learned from its failure.

**Lakshmi.S & Muthumani's (2016)** study determines consumers' purchase decisions and behaviour towards quality products. Acceptance of a brand depends mainly on the consumers' opinions. The study investigated consumers' views, attitudes, and beliefs about brand quality. The convenience sampling method has been adopted to identify samples from the population. SPSS package was used to analyse the data using the chi-square test and multiple regression analysis. It is concluded that brands win the battle for awareness. Brand awareness is the battle of mind; thus, it cannot be won without in-depth knowledge of one's strengths, weaknesses and competitive outlook—the study insights into consumer perception governing purchase decisions.

**Bennett . R., & Vijaygopal, R. (2017)** investigate the effects of gamification on connections between consumers' self-image congruence about the purchasers of environmentally friendly products, Electric Vehicles (EVs). The attitudes towards EVs, their levels of environmental concern, and prior knowledge of EVs. Additionally, the research explored the willingness to purchase EVs.

**Bhalla P, & et al. (2018)**, this paper studied the factors influencing the consumer acceptance of electric vehicles. The result shows that environmental concern and

consumer trust in technology are the antecedent factors for the perception of Electric vehicle purchase. Cost, infrastructure, and social acceptance are the factors that give adoption a blowback. Thus, to promote sales of electric vehicles, the government has to play a leading role by creating environmental policy and infrastructure and subsidising the cost of cars or lowering the bank's interest rate.

**Acharya .S. ( 2019)** shows that the automobile sector produces harmful gases, i.e. carbon dioxide and adds to the environment. Promoting green vehicles to reduce their effect on the environment is necessary. Concerning environmental issues, the world has unforeseen natural calamities like floods, famine, earthquakes, tsunamis, etc. This report essentially provides an in-depth study of customers' attitudes and perceptions towards Green Vehicles. It tries to answer fundamental questions affecting consumers' awareness level and preference for an environment-friendly car over a standard one.

**Tupe O, Kishore.S &Johneira A. (2020)** suggested that with the current depletion of fossils and its price hike, there is a need for other energy resources to run the vehicles. The automobile sector considers Electric Vehicles a situation for industry and the environment. However, the current market penetration of EVs is relatively low despite the government's implementation of EV policies.

**Hussain M & et al. (2020)** studied **global warming** as one of the most acute challenges in the world, prominently caused by greenhouse gases. Introducing hybrid Vehicles (HVs) is one of the industrial initiatives that tackle this challenge, allowing at least some proportionate reduction in global gas emissions. Such initiatives like HVs have also affected the consumers' green-purchase intention (GPI). Hence, underpinned by the theory of planned behaviour (TPB), this study aims to analyse consumers' response in terms of GPI for HVs, in addition to exploring the moderating effect of price-sensitivity between the independent variables (Attitude subjective norms and perceived behavioural control) and consumers' GPI for HVs.

**Thomas V, A. V.S Abhilash & V Pillai, S (2021)** analysed the consumer perception and purchase intention of electric vehicles in India. The results clearly illustrate that the population knows the environmental benefits. Because environmental sustainability is one of the significant concerns to be addressed, electric vehicles would ultimately aid in achieving the same as the carbon emissions from electric cars, which are almost 90% lower than those of conventional vehicles.

## **Objectives**

- To study the consumer perception toward electric vehicles.
- To compare the perception level of consumers of Lucknow and Dehradun.

## **Research Methodology**

### **Sampling**

Purposive and random sampling techniques were used to select areas, states, districts, and respondents and collect data. At first, the stages, i.e. Uttarakhand and Uttar Pradesh, were chosen for study based on the availability of electric and non-electric vehicles in the state and getting local support easily compared to other areas.

In the second stage, one district from each state, i.e. Lucknow from Uttar Pradesh and Dehradun from Uttarakhand, was finally selected for the present study. Keeping given helping hand availability in these districts during the data collection, the above districts were selected.

In the third stage, a list of the electric vehicle owners and other conventional vehicle holders was collected from the respective RTO office, and 500 respondents (250 from each district) were selected by following lottery systems/random sampling methods.

Finally, the primary data were collected from the selected households by conducting a personal interview with the vehicle's owner through the survey method.

### **Sample Size**

The present study sampled 500 households or respondents (250 from each district) selected from two different districts belonging to separate states: Dehradun District in Uttarakhand and Lucknow District in Uttar Pradesh.

### **Likert Scale**

A Likert Scale is a closed-ended survey question that measures a participant's opinion on a series of statements. Likert Scale can have five, seven, or nine points depending on the depth level required from respondents. The scale is named after Rensis Likert, who developed the method in 1932 to determine respondent attitudes towards a topic.

This study applied a five-point Likert scale weightage score ranging from 1 to 5, i.e. strongly disagree (1), disagree (2), Neutral (3), agree (4), and strongly agree (5). The respondent's opinions and views were recorded as weightage scores for analysing consumer perception in the automobile sector.

### Multiple Regression

The perception of consumers may be positive or negative personal. The relation between the dependent variable (Y) (consumer perception) and explanatory variables, i.e. x1, x2, x3, and x4, were tested in the four mathematical /statistical models, namely linear, log-linear, and semi-log models. First, the four mathematical models were tested, and the results were compared in the form of the value of the coefficient regression determinant ( $R^2$ ) of different models. The correlation coefficient value of independent parameters and their relationship with the dependent variable were considered and compared with each mathematical model. The best-fit criteria were followed, and the model was selected based on the value of coefficient regression determinants ( $R^2$ ) and a significant number of correlation coefficients of independent variables used and relation with the dependent variable at a substantial level were the criteria for selecting the best-fit model for further analysis and interpretation of the result. In the present situation, the log-linear mathematical model was found suitable and used in the second stage of running the data.

### Data Analysis and Interpretation

**Table 1 Classification of Respondents' Fuel-Basis of different types of Vehicles**

Fuel Based	No of Respondents		Overall
	Dehradun	Lucknow	
Electric	150 (60)	200 (80)	350 (70)
Diesel	19 (7.6)	1 (0.4)	20 (4)
Petrol	64 (25.6)	19 (7.6)	83 (16.6)
Petrol +CNG	10 (4)	21(8.4)	31 (6.2)
Both Petrol and Diesel	7 (2.8)	3 (1.2)	10 (2)
Both Petrol and Petrol	0 (0)	6 (2.4)	6 (1.2)
Total	250 (100)	250(100)	500 (100)

Source: Author's Primary survey data, Figures in parenthesis Indicate the percentage of total

The above table revealed the classification of respondents based on the types of different fuels used in the vehicles in both the survey areas, i.e. Dehradun and Lucknow. It was seen from the table that, overall, nearly 10 per cent of owners had doubled the number of conventional fuel-based vehicles compared to electric cars. It was further

observed from the table that 2.8 per cent of the respondents in Dehradun city and 3.6 per cent of respondents in Lucknow city had double conventional fuel vehicles in the survey areas. The table further revealed that nearly 20 per cent of respondents had only single-fuel base vehicles, i.e. petrol or diesel. The single conventional fuel vehicle users saw higher (33 per cent) in the case of the Dehradun as a counterpart of Lucknow (8 per cent). However, it is interesting to mention here that the number of electric vehicle users was higher (80 per cent) in the case of Lucknow as against Dehradun (60 per cent).

**Table 2 Age-wise and gender-wise distribution of sample households**

Age Group	Male		Female		Total		Overall
	Dehradun	Lucknow	Dehradun	Lucknow	Dehradun	Lucknow	
<20	8 (1.6)	6 (1.2)	4 (0.8)	2 (0.4)	12 (2.4)	8 (1.6)	20 (4.0)
20-29	30 (6.0)	40 (8.0)	4 (0.8)	8 (1.6)	34 (6.8)	48 (9.6)	82 (16.4)
30-39	104 (20.8)	112(22.4)	8 (1.6)	10 (2.0)	112 (22.4)	122 (24.4)	234(46.8)
40-49	70 (14.0)	60 (12.0)	2 (0.4)	2(0.4)	72 (14.4)	62 (12.4)	134(26.8)
>50	20 (4.0)	10 (2.0)	0 (00)	0 (00)	20 (4.0)	10 (2.0)	30 (6.0)
<b>Total</b>	<b>232(46.4)</b>	<b>228(45.6)</b>	<b>18(3.6)</b>	<b>22(4.4)</b>	<b>250 (50)</b>	<b>250 (50)</b>	<b>500 (100)</b>

*Source Author's Primary survey data, Figures in parenthesis Indicate the percentage to total.*

The table shows respondents' age- and gender-wise classification, and five age groups used the vehicles in survey areas. It is observed from the table that the majority of the sample households belong to the age group of 30-39 years (46.8 per cent), followed by the 40-49 age group (26.8 per cent) and the age group of 20-29(16.4 per cent). The other age group is the less utilised vehicle. This may be due to less availability of family members below the age of 20 and more than 50. These age group members used the vehicles only on casual, personal, and occasion, i.e., students going to school or the market when required. The people attending the office are aged more than 50.

It is further observed from the table that women who are using vehicles occasionally used vehicles for their personal use as well as commercial purposes belong to the age group of 30-39, followed by 20-29 and 40-49 in both survey areas but slightly higher in case of Lucknow than that of Dehradun who were contributing their services in the different activities of family and helping to the family members.

**Table 3 Occupation-wise distribution of respondents**

Occupation	Dehradun			Lucknow			Total		
	Male	Female	Total	Male	Female	Total	Male	Female	Total
Commercial Based Driving	170 (34)	0(00)	170 (34)	170 (34)	0(00)	170 (34)	340 (68)	0(00)	340 (68)
Personal purposes	62 (12.4)	18(3.6)	80 (16)	58 (11.6)	22(4.4)	80 (16)	120 (24)	40(8)	160 (32)
Total	232 (46.4)	18(3.6)	250 (150.6)	228 (45.6)	22(4.4)	250 (50.6)	460 (92)	40(8)	500 (100)

Source: Author's Primary survey data. Figures in parenthesis Indicate the percentage of the total.

Table No-3 shows the distribution of sample respondents based on their full-time engagement in driving operations who adopted their driving skills as a source of income using personal vehicles and hiring out their services to other vehicles. Another category of the respondents was driving vehicles, especially need-based ones, for which they were not paid for driving work. It is further seen from the table none of the females in the survey areas were hiring out their driving skills as a source of income for the family. Still, on the other hand, the reverse situation was observed where females were helping in various types of need-based activities like taking children from school, local markets, and other petty activities for which the vehicles were required. This indicated that hardly any females were allowed by their family members to drive jobs on a hire-out basis. In the overall situation, 68 per cent of sample households were engaged in a full-time driving job in survey areas.

**Table 4 Classification of Respondents based on Monthly Income**

Income	Male		Female		Total		Overall
	Dehradun	Lucknow	Dehradun	Lucknow	Dehradun	Lucknow	
Less than 25000	160 (32)	150 (30.0)	1 (0.2)	2 (0.4)	161 (32.2)	152 (30.4)	313 (62.6)
25000-50000	14 (2.8)	8 (1.6)	2 (0.4)	4 (0.8)	16 (3.2)	12 (2.4)	28 (5.6)
50000-75000	25 (5.0)	3(0.6)	5 (1.0)	4 (0.8)	30 (6.0)	34 (6.8)	64 (12.8)
75000-100000	18 (3.6)	20 (4.0)	6 (1.2)	7 (1.4)	24 (4.8)	27 (5.4)	51 (10.2)



More than 100000	15 (3.0)	20 (4.0)	4 (0.8)	5 (1.0)	19 (3.8)	25 (5.0)	44 (8.8)
Total	<b>232</b> <b>(46.4)</b>	<b>228</b> <b>(45.6)</b>	<b>18 (3.6)</b>	<b>22(4.4)</b>	<b>250 (50)</b>	<b>250 (50)</b>	<b>500</b> <b>(100)</b>

Source: Author's Primary survey data, Figures in parenthesis Indicate the percentage of total

The respondents who have vehicles at home for their personal/private use and commercial purposes were classified according to their family income during the survey year. The table shows that five income groups of respondents have vehicles in their possession. It is seen from the table that overall, nearly 70 per cent of sample households have a monthly income less than Rs.50,000 per month, whereas, at the district level, Dehradun has a higher number of respondents as compared to Lucknow who have a monthly family income less than Rs.50,000 per month. This indicated that the Dehradun respondents' income level was better than the Lucknow respondents. It is further noticed from the table that nearly 13 per cent of households have a monthly income of between Rs. 50,000 and Rs 75000. However, 10 per cent of respondents have a monthly income of between Rs.75000 to 100000 in the overall situation.

The table shows that 9 per cent of respondents come from families with higher incomes whose monthly income is more than 1 lakh. It is clear from the table that families with a monthly income of more than 75000 may have a permanent income source as employees in private reputed companies or government offices that belong to central or state governments. In this situation, it is necessary to mention here that the majority of government employees who have vehicles higher nearly (5.5percent) in the Lucknow survey area than that of Dehradun (4.8 per cent) households who have their family income between Rs 75000 to more than Rs 1 lakh. It was necessary to mention here that the females employed in any reputed organization earning and contributing to the family income were found to be higher (1.4 percent) in Lucknow than in Dehradun (1.2 percent). This indicated that females in these families had liberty and were allowed to work in the offices and contribute their potential to family development. It was notified here from the table that families with a monthly income between the Rs.50000-Rs.75000 range help in the family development activities so that their family may stand firmly against forthcoming challenges.

**Table-5 Reliability Test using Cronbach Alpha Method**

Reliability Statistics			
Factors	Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	Number of Items
Consumer Perception	.834	.837	18

Source: Author's Primary survey data

The consumer perception toward electric vehicles' reliability was estimated using the Cronbach alpha Likert scale with 5 points, with the help of 18 items, using 500 samples, and the size was 0.834. This value is more significant than 0.7, which is considered suitable for the internal consistency of the respondent's views. It is also notable here that the estimated values above 0.51 were supposed to be up to the mark. The consumer perception in which 18 items were considered for estimation and value was more than 0.51. The respondents expressed their view in favour of vehicles, which indicated strong support from most vehicle users.

**Consumer Perception Index of Electric Vehicle Users**

Maximum =Mean +SD and Minimum=Mean-SD

The formula used for the Percept Index of vehicles user =  $\frac{\text{Total weightage score of respondents}}{\text{No.of major factor}}$

**Table 6 Consumer Perception Index of Electric Vehicle Users**

Sr. No	Factor	Category	Dehradun		Lucknow	
			Index Value	No. of Respondents N=150	Index value	No. of respondents N=200
1	Environmental Concern	Lower	Less than 317.26	19(12.67)	Less than 378.51	45(22.5)
		Medium	Between 317.26 to 505.65	100(66.67)	Between 378.51 to 521.57	120(60)
		Higher	More than 505.65	31(20.67)	More than 521.57	35(17.5)
2	Price of Vehicles	Lower	Less than 313.92	15(10)	Less than 393.42	30(15)
		Medium	Between 313.92 to 503.52	100(66.67)	Between 393.42 to 549.66	139(69.5)
		Higher	More than 503.52	35(23.33)	More than 549.66	31(15.5)

3	Driving Range	Lower	Less than 307.76	50(33.33)	Less than 369.96	28(14)
		Medium	Between 307.76 to 445.26	74(49.33)	Between 369.96 to 496.62	113(56.5)
		Higher	More than 445.26	26(17.33)	More than 496.62	59(29.5)
4	Infrastructure Facility	Lower	Less than 303.45	42(28)	Less than 383.93	38(19)
		Medium	Between 303.45 to 493.89	58(38.67)	Between 383.93 to 522.91	112(56)
		Higher	More than 493.89	40(26.67)	More than 522.91	50(25)
5	Consumer Perception	Lower	Less than 1224.96	33(22)	Less than 1540.79	37(18.5)
		Medium	Between 1224.96 to 1937.68	85(56.67)	Between 1540.79 to 2085.79	113(56.5)
		Higher	More than 1937.68	32(21.33)	More than 2085.79	50(25)

Source: Author's Primary survey data, Figures in parenthesis Indicated the percentage to total

The consumer perception index of electric vehicles was estimated with the help of five parameters, i.e., environmental concern, money value or budget of the cars, driving range, infrastructure facilities, and purchase intention for electric vehicles. Under environment factors four questions were asked from the respondents. Electric vehicles protect the environment from pollution and save for future generations. Respondents were given a weightage value to individual questions based on their mind's priority. The weightage value given range from 1 to 5 Likert scale weightage. With the help of the weightage value, the family weightage score was prepared, and the mean and standard deviation from the weightage score were estimated. The lower and upper limits of the index were classified and presented in Table 6. Most sample respondents were under the medium index group, indicating that the environment is essential for good health and a better life. 13% of respondents from Dehradun and 23% from Lucknow were unsatisfied with the environmental factors in the lower index category.

Another critical factor was the market value or price of electric vehicles/money value. This having four questions reflects the perception level of consumers, i.e. the price of electric cars, replacement cost of the electric battery, vehicles may not be expensive, and maintenance cost was affordable. The table shows that 67 per cent of households in Dehradun and 70 per cent of respondents in Lucknow were satisfied with the existing questions asked at the time of the interview and came in the range of medium index

value. This indicated that most respondents were satisfied with the features available in the vehicles, which became profitable for electric vehicle holders.

The driving range of the electric vehicles indicates how much distance can be covered by the fully charged battery without taking a rest. Currently, electric cars generally cover nearly 35-40 miles, i.e. 65-70 km, in one time fully charged battery. There were many factors affecting the driving range of electric vehicles. The significant points related to a driving range, engine capacity power, battery types, engine controlling system, temperature reflect the battery, wind velocity, and speed. The slow speed increases the battery's life span, land surface and direction of the driving; upper side or higher alleviation requires more electric power comparatively going down side. Most of the respondents were satisfied with the features available in the driving range of electric vehicles. The higher number of respondents (50 per cent) were in the medium index driving range in Dehradun, and 57 per cent of respondents in Lucknow were in the medium index. It was further observed from the table that 33 per cent of respondents belong to a lower index value of the driving range in Dehradun. It was clear from the data that undulated surface area controlled the speed of vehicles. This is true in the case of Dehradun. The undulated surface area is the factor that reduces the speed of electric cars.

Under the factor's infrastructure facilities, the five questions were taken into account for the opinion of respondents, i.e., battery charging time, recharging facilities, dependency on electricity for charging the battery and poor infrastructure facilities in terms of road condition. It was found that most sample households were satisfied with the available facilities in the survey cities. The value of the infrastructure index indicated that nearly 28 per cent of respondents in Dehradun and 19 per cent of respondents in Lucknow city were not satisfied with the existing infrastructure facilities. This may indicate that the infrastructure facilities for charging the electric batteries, road conditions and quality of electric batteries need to be improved.

**Table 7 Distribution of respondents according to support to different parameters of questions (in percentage) related to consumer perception (Electric Vehicles)**

Factors	Percentage of Respondents		
	Dehradun	Lucknow	Overall
<b>Environmental Concern</b>			
EC1: Electric vehicles are friendly for the environment as they have low emissions.	95.33	85.00	89.71
EC2: Electric Vehicles can protect the environment from pollution.	92.67	86.50	89.71
EC3: Electric Vehicles save the environment from global warming.	90.00	86.50	88.00
EC4: Electric vehicles save the environment for future generations.	90.00	82.50	85.71
<b>Total</b>	<b>92.00</b>	<b>85.50</b>	<b>88.14</b>
<b>Price of vehicles</b>			
PV1: Price of an EV is expensive as compared to conventional vehicles	92.00	86.50	88.86
PV2: Replacement cost EVs battery is high	91.33	87.00	88.86
PV3: Electric Vehicles are inexpensive to use.	89.33	86.00	87.43
PV4: Maintenance cost is average	83.33	87.50	85.71
<b>Total</b>	<b>89.00</b>	<b>86.75</b>	<b>87.71</b>
<b>Driving Range</b>			
DR1: Electric Vehicles are more convenient for short trip than long trip	86.00	83.50	84.57
DR2: Driving of electric vehicles reduce dependency on fuel.	87.33	85.00	86.00
DR3: Electric vehicles is not safe for long range drive.	83.33	85.50	84.57
DR4: Electric vehicles have automated driving system	83.33	80.00	81.43
<b>Total</b>	<b>85.00</b>	<b>83.50</b>	<b>84.14</b>
<b>Infrastructure Facility</b>			
IF1: Electric Vehicles take a long recharging time.	93.33	85.50	88.86
IF2: Recharging is inconvenient	99.33	85.50	91.43
IF3: Infrastructure is well situated for EV.	96.67	80.00	87.14
IF4: Depend on electricity	86.67	86.00	86.28
<b>Total</b>	<b>94.00</b>	<b>84.25</b>	<b>88.43</b>
<b>Purchase intention of Electric vehicles</b>			
PI1: Next time I buy an Electric Vehicle	95.33	89.00	91.71
PI2: I have the intention to drive electric vehicles soon	88.67	87.50	88.00
<b>Total</b>	<b>92.00</b>	<b>88.25</b>	<b>89.86</b>

Source: Authors' Calculation

The table revealed that consumer perception is related to different parameters that contribute to an effective role in the perception level of customers. The four questions interviewed the respondents, who have a crucial role in increasing or decreasing the perception level of the consumers. The conventional vehicles release emission gases and pollute the air and became global problem have negative effect on human life. The emission gas production (carbon dioxide) may be checked using electric vehicles sample households of the survey. Electric vehicles protect the environment from pollution, as reported by 88 per cent of sample households in the overall situation where it lies between 85 per cent to 92 reported by the per cent of respondents of Dehradun and Lucknow, respectively.

The price of electric vehicles was a factor that affected consumers' purchase decisions. From the table, 87 per cent of sample households gave their view and were satisfied with the existing price of electric vehicles, while the remaining respondents were not. The battery problem and maintenance cost were unfavourable, reported by nearly 11 per cent, and 14 per cent of respondents were in the survey areas. Electric vehicle prices were affordable, as reported by the majority (89 per cent) of sample households in both survey areas. However, only 8% of Dehradun and 13% of Lucknow sample households reported that their economic condition was not affordable enough to buy electric vehicles at the existing price.

The vehicles' driving range is one factor that affects consumer perception level. Electric cars were not suitable for long trips and for more people to travel at a time in vehicles. This condition was applicable only in the case of two-wheeler and three-wheeler electric vehicles due to the lower capacity of the battery. These vehicles may not run more than 12 hours after getting one-time recharge.

Infrastructure facilities have a close relationship with consumer perception. Suitable and better infrastructure facilities have a higher level of perception of the consumers, while the reverse was true in the case of poor infrastructure facilities. From the overall situation, 88 percent of respondents were satisfied with the existing infrastructure facility available in both areas. In survey areas, 94 per cent of Dehradun and 84 per cent of people expressed satisfaction with existing infrastructure facilities.

**Table 8 Distribution of respondents according to support in 5 points Likert scale  
Consumer perception (in percentage) Dehradun**

Factors	Types of Vehicles	Percentage of respondents				
		Strongly Disagree (1)(%)	Disagree (2)(%)	Neutral (3)(%)	Agree (4)(%)	Strongly Agree (5)(%)
Environmental Concern	EV	1.17	5.33	1.50	78.17	13.83
	NEV	4.75	8.75	14.50	63.00	9.00
Price of Vehicle	EV	1.67	7.17	2.17	74.67	14.33
	NEV	3.00	6.75	9.75	70.75	9.75
Driving range	EV	2.50	9.30	3.17	69.66	15.33
	NEV	2.75	10.00	16.00	63.00	8.25
Infrastructure Facility	EV	1.67	3.67	1.17	84.50	9.50
	NEV	3.00	7.75	14.75	63.00	11.50
Purchase Intention	EV	1.00	5.67	1.33	80.33	11.67
	NEV	2.50	8.50	11.00	68.5	9.50

Source: Authors' Calculation

Consumer perception towards electric and non-electric vehicles relates to different factors viz; environmental concern, price of cars, driving range and infrastructure facility and consumer purchase intention of vehicles. The majority of the respondents disagreed with three conditions, varying from 4 per cent (infrastructure facility) to 9 per cent (driving range) in the case of electric vehicles, indicating that features of electric vehicles need to be updated, which is suitable for new generations. The condition in which respondents did not express their views had a neutral opinion, and few respondents were found to strongly disagree about the different factors of both.

**Table -9 Distribution of respondents according to support in 5 points Likert scale Consumer perception (in percentage) Lucknow**

Factors	Types of vehicles User	Percentage of respondents				
		Strongly Disagree(1) (%)	Disagree (2) (%)	Neutral (3) (%)	Agree (4)(%)	Strongly Agree(5) (%)
Environmental Concern	EV	2.50	9.37	2.87	60.38	24.88
	NEV	3.00	13.00	10.00	66.50	7.50
Price of Vehicle	EV	2.00	8.75	2.75	62.13	24.37
	NEV	4.00	13.00	11.50	65.00	6.50
Driving Range	EV	2.63	10.50	3.37	62.00	21.50
	NEV	2.50	8.50	10.50	71.50	7.00
Infrastructure Facility	EV	2.75	9.97	3.13	62.75	21.50
	NEV	2.50	9.50	9.50	71.50	7.00
Purchase Intention	EV	1.75	7.50	2.50	65.00	23.25
	NEV	3.00	13.00	10.00	67.00	7.00

Source: Authors' Calculation

Consumers' opinion towards electric vehicles and non-electric vehicles about different consumer perception factors, i.e. environmental concern, price of vehicles, driving range and infrastructure facility and purchase intention, together have a relation with the consumer's perception. It was observed from the table that nearly 15 per cent of sample households were not satisfied with electric vehicles because of unfavourable, i.e. environmental conditions. Most respondents disagreed about all the four factors and varied between nearly 9 percent to 13 percent in case of electric vehicles. It was observed from the table that the price of vehicles reported a lower number (9 per cent) of respondents and the driving range 11 per cent of respondents disagreed with the existing driving range, i.e. 30-40 km per hour at a continuous time. 10 per cent and 9 per cent of respondents disagreed with infrastructure facility and environmental concerns, respectively.

**Consumer Perception Regression Model.**

$$Y=f (X_1+X_2+X_3+X_4.....X_n+\epsilon)$$



Whereas, Y=Dependent Variable, f=function, X<sub>1</sub>,X<sub>2</sub>,X<sub>3</sub> ,..... X<sub>n</sub> =Independent variables

**β<sub>1</sub>, β<sub>2</sub>..... β<sub>n</sub>=Correlation Coefficient, €=Error**

Y= Consumer Perception weightage score (CPWS)

X<sub>1</sub> = Environmental Factor weightage score of Customer view (ECSC)

X<sub>2</sub> = Purchase Price weightage score of Customer view (PPSC)

X<sub>3</sub>= Product Quality weightage score of Customer view (PQSC)

X<sub>4</sub>= Infrastructure Facility weightage score of Customer view (IFSC)

€ = Error

**Multivariate Regression Model Equation**

$$CPWS = \beta_1 ECWS + \beta_2 PPSC + \beta_3 PQSC + \beta_4 IFSC + \epsilon$$

**Table-10 Consumer Perception Regression Model Dehradun**

Particular	Details	Correlation Coefficients				R <sup>2</sup>
Intercept	0.74247	x <sub>1</sub>	x <sub>2</sub>	x <sub>3</sub>	x <sub>4</sub>	0.91037
Variable	4	-0.07304 (0.002016)	-0.05383 (0.0069)	0.02011 (0.00217)	0.01499 (0.00272)	
D.F	145					
Calculated t Value		-36.2318	-7.7172	9.23298	5.5136	

Source: Authors' Calculation, Figures in Parenthesis indicated the standard error value.

Consumers' Perception indicates the personal opinion of the human being about commodities, goods, and services. The result shows that the value of R<sup>2</sup> was 0.9103, pointing to all four parameters having a close association with the dependent variable. It shows that 91.03 per cent variation in the explained variable was due to the independent variable, and the remaining 8.97 per cent variation may be due to the residual effect on the multiple coefficient regression determinant (R<sup>2</sup>). It was further seen from the table that the vehicle's driving range (x<sub>3</sub>) and the infrastructure facility for the vehicle (x<sub>4</sub>) variable were found to have a positive relation with consumer perception towards electric vehicles. The value of the correlation coefficient was 0.020 for the driving range (x<sub>3</sub>) and 0.014 for the infrastructure facility (x<sub>4</sub>), indicating that if a 1 per cent value change of the driving range variable and infrastructure facility variable increased in the form of weightage score, the impact was positive on the dependent variable (consumer perception) by 2.01% and 1.49% variation occurred in

the dependent variable with increasing two variables, respectively. It is also seen from the table that the independent parameters were found statistically significant at a 1 per cent level of significance on 145 degrees of freedom. On the other hand, it was also necessary to explain the relationship between the independent variable of environmental concern(x1) and the price of electric vehicles (x2) having a negative association with consumer perception level in the present time or condition prevailing or faced by consumers. Both variables were statistically significant at a 1 percent level of significance at 145 degrees of freedom. The negative relation of these parameters may be unfavourable and non-acceptable conditions of consumers and negative feelings in consumer minds towards electric vehicles.

**Table-11 Consumer Perception regression model of electric vehicles (Lucknow)**

Particular	Details	Correlation Coefficients				R <sup>2</sup>
		x <sub>1</sub>	x <sub>2</sub>	x <sub>3</sub>	x <sub>4</sub>	
Intercept	0.70651					0.85389
Variable	4	-0.43035 (0.01684)	-0.56903 (0.06505)	0.338606 (0.02216)	0.441551 (0.02788)	
D.F	195					
Calculated t Value		-25.5483	-8.74756	15.28019	15.83373	

Source: Authors' Calculation. Figures in parenthesis indicate the value of standard error.

Consumer perception towards electric vehicles was tested by using four mathematical models, i.e. linear regression model, log-linear mathematical model, semi-log (log taken dependent variable) and semi-log (log taken independent variable). It was analysed at the first stage for finalising the best fit mathematical model for further analysis. The value of multiple determinants, called the coefficient regression determinant (R<sup>2</sup>), is 0.8538, indicating that together, four independent variables have an 85.38 per cent close relation with the dependent variable, and the remaining 14.62 per cent effect was residual on regression determinants (R<sup>2</sup>). It was further observed from the table that variable driving range (x<sub>3</sub>) and infrastructure facility (x<sub>4</sub>) having coefficient correlation values 0.3386 and 0.4415 indicated that 1 per cent level of driving range and infrastructure facility increased the value of dependent variable increased by 33.86 percent, and 44.15 percent, this shown the variation in the dependent variable. These two variables were statistically significant at a 1 percent level of

significance of 195 degrees of freedom in the case of Lucknow. It was interesting to mention here that the same variables were statistically significant in the case of Dehradun at 145 degrees of freedom. Surprisingly, the relationship between the variable environmental concern (x1) and the price of electric vehicles (x2) was found to have a negative relation with the dependent variable (consumer perception) observed from the result shown in Table 11. It was further noticed that the value of the correlation coefficient of environmental concern (x1) was -0.43035, and the price of vehicles (x2) was -0.5690, indicating that the level of x1 and x2 increased by 1 percent. The variation came in the dependent variable by 43.03 percent and 56.90 percent due to said independent variables. These variables were statistically significant at a 1 percent significance level at 195 degrees of freedom. This indicates that environmental concerns and the price of electric vehicles were not favourable to consumer perception.

### **Findings**

1. The majority of the sample households belong to the age group of 30-39 years (46.8 percent), followed by the 40-49 age group (26.8 percent) and the age group of 20-29(16.4 percent). The other age group is the less utilized vehicle.
2. It is seen from the table that overall, nearly 70 percent of sample households have a monthly income of less than Rs.50,000 per month, whereas, at the district level, Dehradun has a higher number of respondents as compared to Lucknow, who have a monthly family income less than Rs.50,000 per month.
3. Consumer perception of electric vehicles' reliability was estimated using the Cronbach alpha Likert scale with 5 points and 18 items, using 500 sample sizes of 0.834.
4. Overall, 88 per cent of respondents were satisfied with the existing infrastructure facility in both areas. In survey areas, 94 per cent of Dehradun and 84 per cent of people expressed satisfaction with existing infrastructure facilities.
5. It has been observed from the survey areas that consumer perception is apparent in terms of infrastructure facilities, driving range of the vehicles, environmental concern of the area, and price of vehicles may together increase or decrease according to the better and lower level of facilities available in the survey areas.

6. The result shows that vehicle users are interested in shifting their choice of electric vehicle use or purchasing compared to conventional fuel vehicles, i.e., diesel, petrol, and other traditional fuels such as CNG, LPG, etc.
7. It was further seen from the table that the driving range of the vehicle (x3) and the infrastructure facility for the car (x4) variable were found to have a positive relation with consumer perception towards electric cars. On the other hand, it was also necessary to explain the relationship between the independent variable of environmental concern(x1) and the price of electric vehicles (x2) having a negative association with consumer perception level in the present time or condition prevailing or faced by consumers.

## **Conclusion**

It is concluded from the results that the interest in using electric vehicles is increasing among vehicle users and shifting their desire to have electric cars.

From the above facts, it may be concluded that the population in survey areas is very conscious about a clean environment and better health. There is a bright future in the market for electric vehicles, and they are contributing a significant role in reducing carbon dioxide levels and air pollution. The electric vehicle is a better option than fuel-based vehicles to protect the environment and the health of human beings on earth. It may be concluded that the consumer perception of electric cars depends on various factors, such as whether those are favourable or not for electric vehicles. where consumers live and have favourable or non-favourable conditions for electric cars.

## **Suggestion**

- It may suggest that better quality electric battery vehicles must be manufactured.
- They suggested that the quality of electric vehicles needs to be improved to reduce the maintenance cost of vehicles.
- It may be suggested that recharging facilities at an approachable level must be created at a priority level by the government or social trust so that consumer perception towards electric vehicles may not be hurt.

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