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"Purchase Intention of Electric Vehicles: An Empirical Study in Bangalore"

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ABSTRACT

Electric vehicles have attracted the attention of India's policy makers as clean technology alternatives. The opportunities for India's mobility future are massive. As an oil import dependent country, the energy scarcity is another challenge ((Patil, May 2019). Electric vehicle is a new way of transportation having no air, noise pollution and an environmentally friendly way to commute. Contemporary environmental concerns are thrusting the manufacturing and sales of Electric vehicles. The purpose of this paper is to explore the role of performance features, financial benefits, environmental concerns, social influence, cost of ownership and infrastructure support on purchase intention of Indian consumers towards Electric Vehicles (Ali, July 2018). The study focuses on exploring purchase intentions with key marketing factor influencing buying decision of Electric Vehicles. This research is essential in the current market condition of India, as there is a huge push from the government to adopt Electric Vehicles and there is a lack of recent studies on this topic in India, which entails a gap in the scientific literature. India being a major market for electric vehicle and government plan to be an electric vehicle country by 2030 is a major ambitious plan and to achieve this aims to check the acceptability of people towards electric vehicle and its effect on automobile industry.

Introduction:

Government around the world are implementing policies to promote electric vehicles to reduce dependence on oil, decrease greenhouse gas emissions and improve air quality. The opportunities for India's mobility future are massive. The climate risk index released by the government; India's rank has worsened from the in the global vulnerability ladder. 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. Major auto

manufacturers are looking at this widely untapped sector with hope.

India wants to become a global hub of manufacturing of electric vehicles, challenges are to create a competitive advantage in electric vehicle are to increase infrastructure to match with the current leader in electric mobility, china. The government wants to achieve a market share of 30% in electric vehicle by 2030 like slashing of GST, Tax exemptions on loans, Custom duty exemption on Electric vehicle parts, setting up charging stations. By taking an enthusiastic, consultative and progressive approach to encouraging clean mobility, central and state governments across India have made significant commitments towards promoting an electric future. Today, India is one of the fastest growing economies in the world, but its increasing dependency on oil imports, rising environmental concerns and growing need for sustainable mobility solutions are posing serious economic and social challenges. Over the past few years, India has announced a plethora of electric mobility policies and regulatory measures, including the recent budgetary announcements as well as an allotment of INR 10,000 crore by the cabinet to promote the faster adoption and manufacture of electric vehicles across the country (agyog, 2014).

Table 1: EV Sales in India (2014–15 to 2019–20)

Segment	FY16	FY17	FY18	FY19	FY20
e-2-wheelers	20,000	23,000	54,800	126,000	152,000
e-4-wheelers	2,000	2,000	1,200	3,600	3,400
Buses					600
Total	22,000	25,000	56,000	129,600	156,000

(**Sources**: CarandBike,[9] Inc42 Media,[10] AutocarPro,[11] Bloomberg Quint[12])

According to recent industry data (Source: Economic Times, Autocar India) in the first eight months of FY 20, EV sales were a mere 0.7 percent of total passenger vehicle sales in the country. This is much lower than the global average of 2.7 percent which is too lower side due to the slow growth in emerging economies. In FY 20, the total passenger EV sales were 0.15 million in India in comparison to annual sales of 2.1 million globally in 2019. The onset of the covid-19 pandemic has necessitated a policy shift or even an overhaul in various sectors of the economy. Within this shift the Indian government must also rework for the EV sector. Types of Electric car are:

A)   Solar-powered electric cars and vehicles
B)   Hybrid electric cars powered by a mix of internal combustion and batteries
C)   Electric cars with on board battery electric vehicle (BEV)
D)   Plug in hybrid electric vehicles (PHEV)

China and United States have 65% of market share of global Electric four wheeler users, followed by Europe which is 23%. India has less then 1% in Electric four wheelers market. The first electric car of India was REVA from Maini group, Some of the well know brands in India in Electric car are TATA Tigor & Nexon, MG ZS, Hyundai Kona, Mahindra Verito and E2O and the upcoming brands Mercedes E100, Audi e-tron Porsche Taycan and most promising is TELSA's elon musk (Forum, 2018).

Initiative of the Indian Government Towards Electric Vehicles:

➤ FAME-Faster adoption and manufacturing of (Hybrid and Electric) vehicles in India
➤ Member country of Electric Vehicle Initiative
➤ National Electric Mobility Mission Plan 2020
➤ National Mission on Electric Mobility
                    (Source: Autoportal.com)

The research paper is organised in the following parts: In the first part is introduction to purchase intention of electric vehicles, provides a relevant literature review for the theoretical framework and hypotheses development. The next section describes the research methodology and measurement. The following section presents the main findings of the study. The last section describes and conclusion along with limitations and implications for marketers and policymakers.

Review of Literature:
Moyo.N, [2018], analysed how environment concern plays a significant influential role in the purchase decision of electric vehicles, the findings reflect the consumers who are environmentally concerned are more willing to purchase electric vehicles to protect their environment from air pollution. Some of the most influential value orientations are egoistic, social-altruistic and biosphere more identified in purchase intention of electric vehicles. Franchon lio, Eric Molin and Brek Van Wee, [2016] gave emphasis on Electric Vehicle penetration is relatively low in spite of many govt implementing strong promotion policies. Paper presents a comprehensive review of consumer preferences for electric vehicles and aiming for better policy and research in this area. Pretty Bhalla and Inass, J [2018] empathized on manufacturing and sales of Electric Vehicles. Many factors contribute to influence the purchase decision of car buyers such as environmental issues, cost, trust, technology advancement, infrastructure and society acceptance. To promote sales of electric vehicles government has to play a lead role in policies, infrastructure, subsidy, lower bank rate of interest etc.
Bharathi Motwani and Abhishek Patil, [2019], gave importance to advantages of Electric Vehicle as a new way of transportation having no noise, air pollution and an environmentally friendly way to commute. India being a major market, this study was conducted to check the acceptability of people towards electric vehicle and its effect on automobile industry. The study focusses on people opinion and the awareness about the electric vehicle. Today all vehicle producer in the world have at least on electric vehicle in their product portfolio. Mishra.S and Malhotra, [2019] identified a potential need for adopting alternative technologies in automobiles such as Electric Vehicles. Study focuses on the role of performance features, financial benefits, environment concerns, social influence, cost of ownership on purchase intention of Indian consumers towards Electric vehicles.
Environmental concern and performance features were two factors which considered most important in consumer behavior of Electric vehicles. [Korakrich Montain and Nanthi Sutjikarnnarunai, [2019] understood the need for Infrastructure factor and Financial factor found very important as modern vehicle technology with a rapid development which will alleviate the problems of energy, air pollution and global

warming which are becoming more severe. Study helps in understanding correlations between the demographic variables and purchase intention towards Electric vehicles in the future.

Research Design
Statement of the Problem
Popularity of electric vehicles is increasing over the years, but the market ratio of these electric vehicles are still very low, the key to this study is to understand how consumers accept electric vehicles and factors influencing consumers intention towards purchase of electric vehicles. Therefore the study aims to understand some of the factors influencing purchase of electric vehicles are price, safety, recharging infrastructure, government policies. Due to current environmental problems caused by regular vehicles, the global aim is to diminish greenhouse gas emissions. In order to do so, conventional vehicles would have to be replaced by alternatively driven vehicles such as the Electric Vehicle. However, the launch of Electric Vehicles is still in the initial stage and hesitant. For that reason, it is of great interest which factors are of importance to consumers when making product- and consumer-related buying decisions related to vehicles.

Objectives of the study
1.   To study the trends in Electric vehicles over the past decade globally in general and India in Particular.
2. To captive the factors that potential buyers of Electric vehicles consider important while buying Electric vehicles.
3. To captive the perception of select respondents towards Electric Vehicles.
4. To do the gap analysis of preferences vis a vis perception of select respondents towards Electric vehicles.
5. To offer constructive suggestions for stakeholders.

Methodology
Sample & Procedure
Non random sampling techniques were used and sample comprised of owner of fuel cars. Data was collected from customers who were every day user of fuel cars. Based on the sample it was assumed that the entire population was well aware of technology used in fuel cars and potential benefits of using electric cars.
Statistical Tools Used
A survey questionnaire was developed, which was used for the study. As both, benefits and barriers might be based on environmental cost, comfort, trust and technology, social acceptance, infrastructure availability argumentations for both cars and electric cars. Researcher has assumed these factors have a direct influence on individual choices of the vehicle. The first section of questionnaire was related to demographics of respondents. Respondents' views about various parameters that effect purchase decision was analysed.
Analysis of the Data
The collected data were tabulated as per the research design to meet out the objectives of the study and suitable statistical tools were used to analyse the data.
Population and Sample

The population of this study is in Bengaluru City. Samples are selected from Bengaluru Metropolitan region. This research was initially conducted on the sampling of 125 respondents by Non probability Sampling with a focus on the research objective.

Research Gap fulfilled by the Study

Popularity of electric vehicles are increasing over the years, but the market ratio of these electric vehicles are still very low, the key to this study is to understand how consumers accept electric vehicles and factors influencing consumers intention towards purchase of electric vehicles with reference to encourage a holistic approach to Electric vehicle adoption and acceleration in the country. Some of the potential areas where research in this field can be undertaken are

Real Purchasing Behavior of Electric cars

Challenges for Electric Vehicles in India

Govt policies and Charging Infrastructure for Electric Vehicles

Data analysis and statistics

The descriptive statistics of the study uses percentage and means. The average score is an assessment of the results based on the analysis of five levels; the result of each factor is the analytical interpretation of Means Scores evaluation. The cross-table analysis was applied to get the two-dimensional whether there are relationships between demographics variables and the purchase intention of Electric Vehicles.

E-Vehicle Perception

Demographic profile

Table 1.1

Particulars	Count	Percentage
Gender. Female	48	38.4
. Male	77	61.6
Type_vehicle1.Electric Bike	2	1.6
Type_vehicle1.Electric car	2	1.6
Type_vehicle1.Petrol bike	60	48.0
Type_vehicle1.Petrol/ diesel car	75	60
Education.PG	53	42.4
Education.Professional	23	18.4
Education.UG	46	36.8
Education.Upto to Inter/PU	3	2.4
Profession.Employed in private sector	39	31.2
Profession.Employed in public sector	18	14.4
Profession.Self Employed	12	9.6
Profession.student	56	44.8
Annual_income.10 to 20 lacs	14	11.2
Annual_income.5 to 10 lac	46	36.8
Annual_income.Below 5 lacs	53	42.4

Annual_income.Not disclosed	12	9.6
Marital_status.Married	38	30.4
Marital_status.Single	46	36.8
Marital_status.Unmarried	41	32.8
Family_Size.Four to Six	83	66.4
Family_Size.One to three	42	33.6

Interpretation: The above table shows that 77% are male, 42.4% have master degree, 44% are students, 42.4 have monthly income of below Rs 500000, 36.8% are single in marital status, 66.4% have four to six in family size

Brand Awareness about Electric Cars

Table 1.2

Brands	Count	Percentage
TATA Nexon	66	52.8
Hyundai Kona	50	40
Mahindra Verito	44	35.2
Mahindra E2O	32	25.6
Morris garage	22	17.6
TATA Tiguar	22	17.6
Mercedes	5	0.04

Interpretation: Tata Nexon has high brand awareness 52.8%, followed by Hyundai Kona 40%.

Sources of Information about Electric Cars

Table 1.3

Sources	Count	Percentage
Advertisement	68	54.4
Product reviews	29	19.2
Personnel Communication	28	18.4

The data shows advertisement (54.4%), main source of electric vehicle information followed by product reviews (19.2%).

Descriptive statistics

Table 1.4

Table showing factors considered important for consumers to buy electric cars

Statements	Particulars	Mean	Sd	Min	Max
IM01	P (Price)	4.45	0.77	1	5
IM02	T (Trend)	3.77	0.88	1	5
IM03	LM (Low Maintenance)	4.16	0.78	2	5
IM04	LN (Low noise)	3.88	0.99	1	5
IM05	VC (Vehicle Capacity)	4.01	0.76	2	5
IM06	LE (Look &Easthestics)	4.15	0.85	2	5
IM07	SP (Speed & Pick up)	4.34	0.72	2	5
IM08	RP (Riding Pleasure)	4.34	0.72	2	5

IM09	AB (Air Bag)	4.37	0.72	2	5
IM10	SW (Service Warranty)	4.44	0.68	2	5
IM11	DT (Delivery Time)	3.58	1.01	1	5
IM12	EF (Environment Friendliness	4.04	0.88	1	5
IM13	S (safety)	4.62	0.69	2	5
IM14	TR (Test Ride)	3.90	0.90	1	5
IM15	PU (Product Upgradation)	3.76	0.90	1	5
IM16	FO (Finance Options)	3.88	0.92	1	5
IM17	IN (Incentives by Govt)	3.59	1.02	1	5
IM18	LS (Life Span)	4.38	0.67	2	5
IM19	RV (Resale Value)	4.10	0.90	1	5
IM20	CH (Charging)	4.13	0.86	1	5
IM21	ST (Sturdiness)	3.90	0.84	2	5
IM22	NT (New Technology)	4.21	0.84	2	5

Interpretation: The factors that are very important for choosing electric cars are Safety, Service Warranty, Price, Life Span, Speed & Pick up, Riding Pleasure, with an average of 4.62, 4.44, 4.45, 4.38, 4.34, and 4.34 respectively.

The factors that are important for choosing electric cars are Test Ride, Low noise, Trend, Delivery Time, Product Upgradation with an average of 3.90, 3.88, 3.77, 3.58, and 3.76 respectively.

EFA Importance of EV

Table 1.6

Table showing exploratory factor analysis for importance of buying Electric Vehicle

Statements	ML2	ML3	ML1	ML4	ML5
IM20_(Charging)	0.51				
IM22_(New Technology)	0.65				
IM17_ (Incentives by Govt)		0.67			
IM19_(Resale Value)		0.61			
IM03_(Low Maintenance)			0.5		
IM04_(Low noise)			0.99		
IM09_(Air Bag)				0.6	
IM13_ (safety)				0.73	
IM05_(Vehicle Capacity)					0.59
IM02_(Trend)					0.41
IM08_(Riding Pleasure)	0.45				

IM10_(Service Warranty)				0.41	
IM11_(Delivery Time)					0.36
IM15_(Product Upgradation)	0.32				
IM18_(Life Span)		0.49			
IM21_(Sturdiness)	0.43				
Eigen value	3.953	1.737	1.427	1.375	1.237
Prop. Var.	9	9	9	8	6
Cum. Var.	9	19	28	36	41
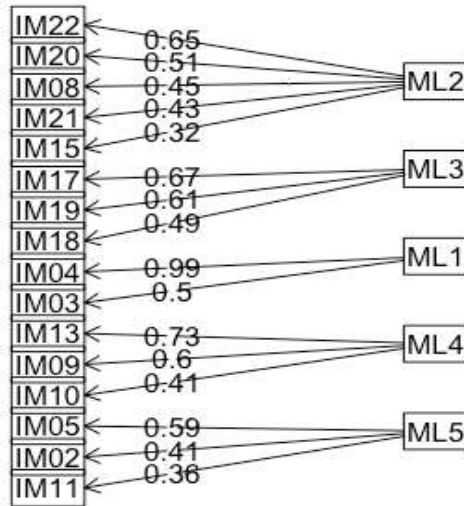
Table factor analysis key statistics

Statements	statistics
Bartlett test of sphericity Chisquare (df)	368.51 (120)
P value	.000
KMO	0.72
RMSR	0.054
CorrRMSR	0.034
TLI	0.987
Fit	0.802
Extraction	ML
Rotation	oblimin
Eigen value	>1
No_Factors	5
Communalities	>.5

Table factor correlation

	fac1	fac3	fac2	fac4	fac5
fac1	1.000	0.347	0.257	0.332	0.441
fac3	0.347	1.000	0.269	0.324	0.217
fac2	0.257	0.269	1.000	0.200	0.256
fac4	0.332	0.324	0.200	1.000	0.298
fac5	0.441	0.217	0.256	0.298	1.000

Interpretation: Key driver analysis has two approach 1. Plotting average importance and average SAT score across the sample 2. plotting X axis as actual SAT score and Y axis as correlation coefficient between SAT mean score and Intention to purchase EV cars in nearby future.

Pr(Price) Td(Trend) Lm(Low Maintenance) Ln(Low noise) Vc(Vehicle Capacity) Le(Look & Aesthetics) Sp(Speed & Pick up) Rp(Riding Pleasure) Ab(Air Bag) Sw(Service Warranty) Dt(Delivery Time) Ef(Environment Friendliness Sf(safety) Tr(Test Ride) Pu(Product Upgradation) Fo(Finance Options) In(Incentives by Govt) Ls(Life Span) Rv(Resale Value) Ch(Charging) St(Sturdiness) Nt(New Technology)

Stated vs. Derived score
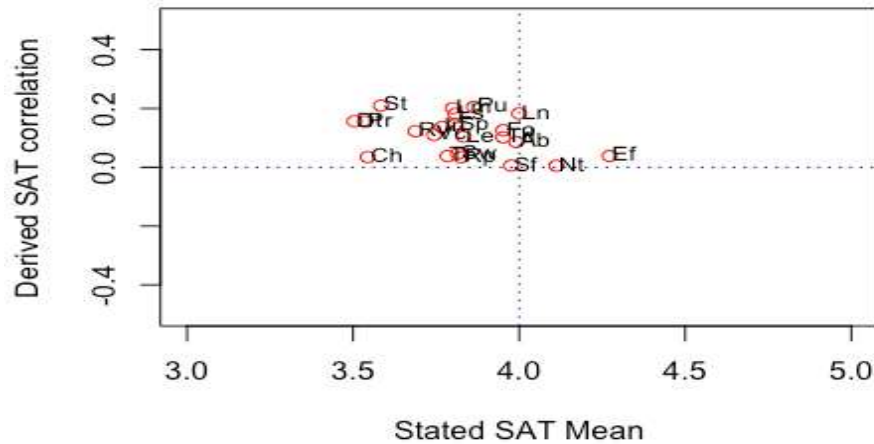
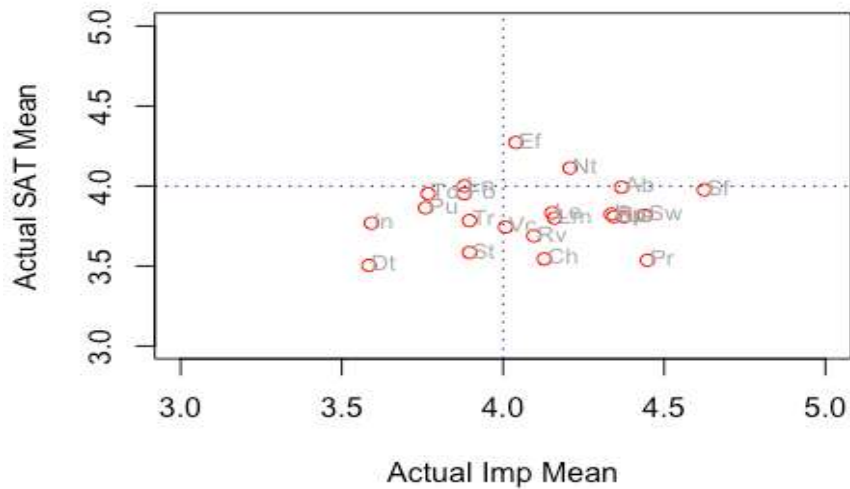## Imp vs. SAT mean score

	Imp_score	Sat_score
Pr	4.45	3.54
Td	3.77	3.95
Lm	4.16	3.80
Ln	3.88	4.00
Vc	4.01	3.74
Le	4.15	3.83
Sp	4.34	3.81
Rp	4.34	3.82

Ab	4.37	3.99
Sw	4.44	3.82
Dt	3.58	3.50
Ef	4.04	4.27
Sf	4.62	3.98
Tr	3.90	3.78
Pu	3.76	3.86
Fo	3.88	3.95
In	3.59	3.77
Ls	4.38	3.81
Rv	4.10	3.69
Ch	4.13	3.54
St	3.90	3.58
Nt	4.21	4.11

Imp vs. SAT score

Gap identification using Paired sample t test

Sn	variables	Importance		Preference		Mean difference	t value	p value
		Mean	Sd	mean	sd			
1	P (Price)	4.45	0.8	3.54	1	0.91	7.95	< .001
2	T (Trend)	3.77	0.9	3.95	0.9	-0.18	-1.74	0.084
3	LM (Low Maintenance)	4.16	0.8	3.8	0.9	0.36	3.72	< .001
4	LN (Low noise)	3.88	1	4	0.9	-0.12	-1.02	0.31
5	VC (Vehicle Capacity)	4.01	0.8	3.74	0.9	0.26	2.68	0.008

6	LE (Look & Easthestics)	4.15	0.9	3.83	0.9	0.32	3.31	0.001
7	SP (Speed & Pick up)	4.34	0.7	3.81	1	0.54	5.29	< .001
8	RP (Riding Pleasure)	4.34	0.7	3.82	0.8	0.51	6.21	< .001
9	AB (Air Bag)	4.37	0.7	3.99	0.8	0.38	4.29	< .001
10	SW (Service Warranty)	4.44	0.7	3.82	0.9	0.62	7.11	< .001
11	DT (Delivery Time)	3.58	1	3.5	1	0.08	0.77	0.443
12	EF (Environment Friendliness	4.04	0.9	4.27	0.9	-0.24	-2.29	0.024
13	S (safety)	4.62	0.7	3.98	0.9	0.65	6.25	< .001
14	TR (Test Ride)	3.9	0.9	3.78	0.8	0.11	1.2	0.231
15	PU (Product Upgradation)	3.76	0.9	3.86	0.9	-0.1	-0.98	0.33
16	FO (Finance Options)	3.88	0.9	3.95	0.8	-0.07	-0.72	0.475
17	IN (Incentives by Govt)	3.59	1	3.77	1.1	-0.18	-1.53	0.13
18	LS (Life Span)	4.38	0.7	3.81	0.9	0.57	5.92	< .001
19	RV (Resale Value)	4.1	0.9	3.69	1	0.41	3.38	< .001
20	CH (Charging)	4.13	0.9	3.54	1.2	1.08	8.77	< .001
21	ST (Sturdiness)	3.9	0.8	3.58	1	0.31	2.95	0.004
22	NT (New Technology)	4.21	0.8	4.11	0.9	0.1	0.99	0.326

Price, Trend, Low Maintenance, Speed, Pick up, Air Bag, Service Warranty, Safety, Life span, Resale value, Charging as P values of these variables are less than 5% significant towards customers perception of satisfaction and importance in buying electric vehicles.

Summary of Findings:
1)   Male respondents form a majority in purchase intention of Electric cars, highest education in respondents, is Master Degree and Respondents Monthly Income is below Rs 500000. Most of the respondent's marital status is single and a family size of four to six.
2)   Tata Nexon and Hyundai Kona have the highest brand awareness in electric cars.
3)   Respondents learn about electric cars through Advertisement and Product reviews.
4)   Respondents Choose Safety, Service Warranty, Price, Life Span, Speed & Pick up as very important factors in electric cars and Test Ride, Low noise, Trend, Delivery Time, Product Upgradation which were rated as important factors in electric cars.

5)   Environment Friendliness, New Technology, Low noise were highly satisfying factors in electric cars and Resale Value, Charging, Vehicle Capacity, Air Bag were found as just satisfying in electric cars.

6)   Maximum Likelihood in importance of Factor influencing in choosing electric cars are Low Noise & Low Maintenance followed by charging, new technology, riding pleasure and product upgradation.

7)   Maximum Likelihood in satisfaction of electric cars are Low noise, Look & Aesthetics, Riding Pleasure, safety followed by price, low maintenance and charging.

8)   P values of the variables such as Price, Trend, Low Maintenance, Speed, Pick up, Air Bag, Service Warranty, Safety, Life span, Resale value are less than 5% significant towards customers perception of satisfaction and importance in buying electric vehicles

Suggestions
1) If prices are appropriate and there are enough charging stations, Electric Vehicles is a very interesting alternative for the respondents.
2) Expectation of electric cars must be met in terms of battery performance, long life, safety, seating capacity, efficiency.
3) Fuel consumption is higher and becoming scare and costly so it may be necessary to turn to electric cars in the future.
4) Electric Vehicle is the new technology. The government and the related sectors should encourage the public to have a better understanding.
5) Environmentally very friendly, the government should be sufficiently encouraging tosupport the policy and infrastructure for Electric vehicles.
6) More awareness should be done about electric vehicles by more of advertising in local Media, dealer website, placing electric vehicles in prominent locations by the Manufacturers.

Conclusions:
The adoption of new technology or paradigm in any industry is more a function of the cumulative actions of all the players in the industry. Considering development, government policies, responses to new technologies, Indian consumers buying concerns the growth of Internal combustion engine technology will remain in demand. Electric vehicle and hybrid fuel technology will have promising future in India. The government is also planning to offer incentives for manufacturing electric vehicles and batteries to boost economic growth and encourage local manufacturing under its Make in India initiative. The falling cost of batteries could boost India's electric mobility plans, and make it that much easier for electric vehicles to be competitive with those running on other fuels. This will push India towards electric mobility in its own unique style and at its own unique pace. Electric mobility-efficient, sustainable, decarbonising-holds tremendous promise for India.

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