Sustainable transport utilisation: a study on factors influencing electric vehicle adoption intention

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Abstract: The Indian government has launched the National Electric Mobility Mission Plan to replace conventional vehicles with electric vehicles (EVs) in intermittent phases. By taking the perspective of the Indian government, consumer, automakers, and marketers into consideration, this study aimed to identify the influence of the attitudinal, contextual and demographic factors on the consumer EVs adoption intention (AI). Besides, determining the awareness level of consumers towards EVs and the government policy incentives is also embedded in this study. The findings revealed a positive influence to the environmental concerns, perceived behaviour control, and personal norms, and a negative influence to the relative advantage, compatibility, purchase price, and government policy incentives on EVs AI. No significant effect of social norms, driving range, and overall cost was found on EVs AI despite the high correlation (except overall cost). In personal characteristics, only annual household income was found to have a significant influence on EVs AI.

Keywords: adoption intention; AI; electric vehicles; influencing factors.

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1 Introduction

The combustion of fossil fuels (mainly petrol/diesel) through automobiles is the leading cause of global warming, and cars continue to play a prominent role. According to the WHO air quality standards, about 100% of the Indian population is exposed to PM 2.5 and road transport, particularly automobiles playing the most considerable role. Indian auto sector is responsible for 50% of the nation's manufacturing GDP. Despite a sluggish market environment, in April–March 2019, overall automobile exports grew by 14.50%, reports SIAM (Khan, 2019). It is expected that by 2030, the Indian auto market will be the 3rd largest car market across the globe (Booz&co., 2011). Given the gravity of the situation, countries worldwide are waking up to this challenge at a slow pace. The worst effect on environmental pollution has led them to search for sustainable and renewable clean energy alternatives (Kuberan and Alagumurthi, 2019). For instance, the use of emulsified biodiesel (Gopidesi and Premkartikkumar, 2019) or the blending of alternative fuels such as vegetable oils with fossil fuels can help reduce environmental hazards substantially (Baba et al., 2019). To combat pollution, governments of all countries have now framed their national plans to control fossil fuel consumption. Electric vehicles (EVs) are now being seen as the breakthrough technology of the future to control pollution. In a span of a few years, the Government of India (GOI) has imposed BS 4 and 6 emission norms but considering these steps as inadequate; the GOI launched 'NEMMP with the initial goal to enforce Indian automobile manufacturer to make only EVs by the year 2032 (Singh, 2017). However, the situation will be very troublesome and chaotic if CVs are phased out from Indian roads without determining the Indian PCC's intention towards EVs. Indian consumers tend to resist new technologies that are considered unfamiliar or unproved; thus, policy decisions that consider their critical concerns will have a higher level of success. The predetermination of the Indian prospective car consumer's AI towards electric cars is also crucial by the vehicle manufacturer so that the upcoming model of electric cars concur with the level of expectations and standards predetermined by the Indian car consumer. This research study primarily aims to identify the common determinants that influence the Indian perspective car consumer's AI electric cars. In addition, it is also vital to ascertain the level of awareness of Indians towards EVs and NEMMP, and this research is also crucial in this context. The outcome of this research study will be beneficial to Indian potential car consumers and policymakers, car manufacturers, and marketers.

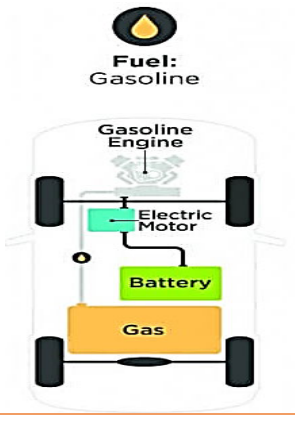
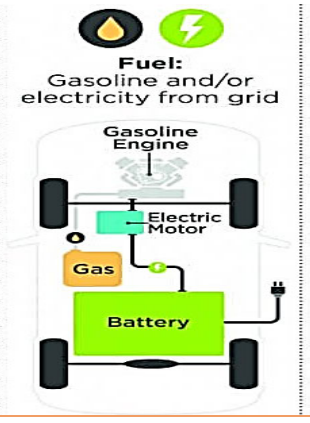
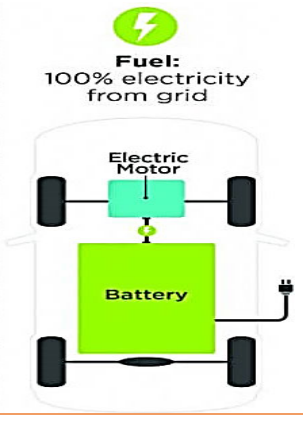
1.1 Electric cars

In simple terms, EVs are any vehicles that use electrical energy drawn from the electric grid and store that energy in a battery (inbuilt) for some or all of the vehicle drive. EVs have recently re-emerged in the global car market due to improvements in battery technology and increased government vehicle efficiency and air quality standards.

Generally, most studies based on EVs consider hybrid electric vehicles (HEVs), plug-in hybrid electric vehicles (PHEVs) and battery electric vehicles (BEVs) as EVs/cars except 'union of concerned scientist' which consider only PHEV and BEV as EVs. All types of EVs can reduce the use of fuel and partially runs on electric fuel, while BEVs can entirely negate the use of fuel and completely run on electric fuel with the help of a big electric battery. All types of EVs worldwide use the power grid to charge and

sometimes discharge their batteries (Vokas et al., 2019). See Figure 1 for more information.

Figure 1 Types of EVs and their characteristics (see online version for colours)

	Plug-in Cars	
Hybrid Electric Car (HEV)	**Plug-in Hybrid Electric Car (PHEV)**	**Battery Electric Car (BEV)**
		
The HEV has an internal combustion engine (ICE), like CVs, which runs on petrol or diesel along with an electric motor powered by a small battery. E.g., Ford Escape Hybrid, Honda Civic Hybrid, Toyota Prius, etc.	The PHEVs are like HEVs with both an ICE and an electric motor, but it has powerful large electric batteries that can be recharged with a plug through an electric outlet. E.g., Chevrolet Volt, Hyundai Ioniq, Mini Countryman, etc.	The BEVs, also called fully electric cars (FEVs), runs purely on battery-powered electricity that can be recharged with a plug through an electric outlet. It has no ICE.
When the car moves on the engine, the battery is charged. It does not come with the plug-in feature to charge the battery.	This car smartly uses an electric motor to save fuel whenever possible and provides power from the ICE if needed. When the battery is fully drained, it runs petrol or diesel.	E.g., Nissan Leaf, Renault Zoe, Tesla Model 3, etc.
Battery power is used at low speed, such as in crowded areas, which saves fuel.		

Source: Image taken from Electric Power Research Institute

2 Theoretical background

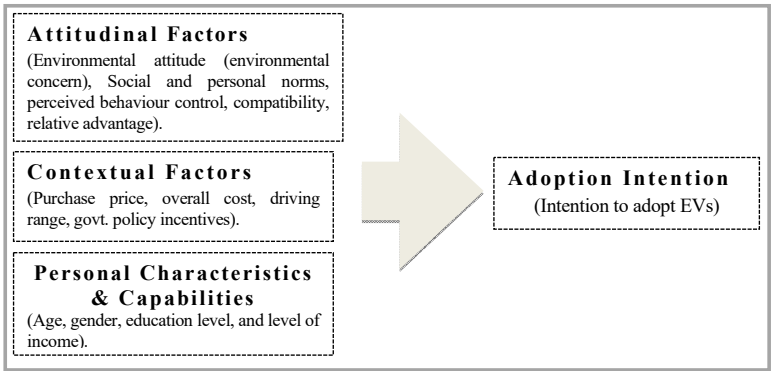
2.1 Theoretical framework

The research on the AI EVs involves several theoretical models, including the theory of planned behaviour (TPB), value-belief-norm theory, cognitive theory, normative theory, technology acceptance model, and others. TPB (Ajzen, 1991) and norm activation model (NAM) (Schwartz, 1977) are the most effective approaches to understand and predict behaviour in the context of climate change mitigation (Schwanen et al., 2011). However, Ozaki and Sevastyanova (2011) argue that these approaches present a rational and linear relationship between consumer beliefs and environmental behaviours but limit perspectives for understanding consumer motivations in the case of alternative fuel vehicles. According to Schwartz, TPB lacks the normative perspective as it undermines the moral or normative influence on SN. In comparison, the role of PN may be more significant than SN in a situation based on moral values. Individual behaviour is usually

guided by an active personal norm that morally obligates one to act in accordance with one's own value system. PN can be activated either by awareness of need, awareness of consequences, expectations of relevant others SN and perceived behaviour control.

The integration process of relevant theories/models from the literature directed the present study to selectively incorporate influencing factors and design a theoretical model to be tested in the Indian context. It was necessary to develop a theoretical model so that the study's hypothesis can be formulated and validated to establish the variables' relationship appropriately. The theoretical framework of the study largely included the variables of TPB and NAM, although, in view of the current Indian scenario, some essential psychosocial, contextual and demographic factors were also included, taking into account the limitations of these theories (see Figure 2).

Figure 2 Model of factors influencing an individual's intention to adopt EVS



2.2 Attitudinal factors

2.2.1 Attitudes

Attitudinal factors include beliefs, values, norms, and attitudes influencing a person's predilection to behave environmentally significant and actual behaviour (Stern, 2000). Attitudinal factors prove to be a very effective determinant in determining the AI environmentally friendly products (Jansson et al., 2010) such as cars EVs. The RA, compatibility, and EC are the most commonly studied attitudinal factors that affect the consumer EVs AI. The RA in terms of financial benefits is strongly related to determining consumers' purchase motivations (Hong et al., 2013). Under compatibility, consumers perceive whether a particular innovation meets their lifestyles, values and past experiences (Kotler et al., 2012). Ozaki and Sevastyanova (2011) and Wu et al. (2015) found compatibility to be significant in terms of consumer purchase motivation in relation to hybrid and biofuel/hydrogen cars. ECs played a much significant role in the early acceptance of new technology. Studies show that consumers concerned about the environment are more intent on adopting EVs than others. (Sang and Bekhet, 2015; Moons and De Pelsmacker, 2015; Wang et al., 2017). However, some studies did not find EC effective (Egbue and Long, 2012; Graham-Rowe et al., 2012; Krupa et al., 2014 (PHEV); Sierzchula et al., 2014).

2.2.2 Social norms, personal norms, and perceived behaviour control

There are enough pieces of evidence that SN are correlated with EVs AI (Kelkel, 2015; Moons and De Pelsmacker, 2012; Sang and Bekhet, 2015, Hamilton and Terblanche-Smit., 2018). However, according to some studies, PN are more effective than SN. Several studies based on empirical research revealed a significant relation between PBC and AI alternative fuel vehicles, including EVs (Hamilton and Terblanche-Smit, 2018) and organic products (Kim and Chung, 2011). SN reduce the social influence on the activation of individual norms, while perceived behavioural control indicates that in some situations, actions are controlled by situational constraints rather than by an individual. PN in an individual are experienced as a sense of moral obligation to act according to one's own value system. PN is also elucidated in the previous point 2.1. Although PN is a less studied factor than SN and PBC, studies that have analysed it have confirmed its essential role in the AI fuel-efficient cars (Peters et al., 2015) and EVs adoption (Egbue and Long, 2012; Skippon and Garwood, 2011).

2.3 Contextual factors

Contextual factors or external conditions include government policy incentives (financial and non-financial incentives, i.e., charging facility) and variables related to EVs such as purchase price, overall cost, driving range. The EVs purchase price (Delang and Cheng, 2013; Lane and Potter, 2007) and overall cost are the financial factors that impact the EVs AI. Since EVs have neither been widely adopted nor experienced by many, drivers may not correctly calculate the cost of ownership (e.g., operating and maintenance costs) (Rezvani et al., 2015). The driving range of EVs is another big concern of the consumer: how many miles can an EV drive with a single charge (Egbue and Long, 2012; Lebeau et al., 2013; Lim et al., 2015; Degirmenci and Breitner, 2017). The EVs currently available in the Indian market offer shorter driving ranges, and EVs capable of delivering longer distances do not come cheap. The government policy incentives (GPI: financial/non-financial) also significantly impact EVs AI. EVs sales tax exemption is the most substantial incentive compared to income tax credits and non-tax incentives (Gallagher and Muehlegger, 2011). Existing literature claims that charging facility/infrastructure is the most influential factor under non-financial incentives and significantly related to EVs AI (Egbue and Long, 2012; Habich-Sobiegalla, 2018) (Brazil). People unlikely to adopt EVs unless they have charging facilities at home (Caperello and Kurani, 2012), the highways (Lane and Potter, 2007) and at work (Jensen et al., 2013).

2.4 Personal characteristics

Personal characteristics, such as gender, age, education, and income, have been found to have a significant effect on an individual's perception. They found to have a much significant role in adopting cleaner vehicles (Potoglou and Kanaroglou, 2007). For instance, Sang and Bekhet (2015) study signified that personal characteristics like gender, age, highest qualification, marital status, monthly household income, current locality are significantly related to EV AI. At the same time, some studies like Sierzchula et al. (2014) found income, education and gender to be non-significant in determining EV

market share within a country. Similarly, Nayum et al. (2013) reported the slight impact of socio-demographic variables in their study.

2.5 Research gap

So far, there have been several retrospective studies studying EVs adoption intent (AI) or other similar proxy variables (OSPVs) of AI. OSPVs of AI are endogenous variables (usually) measured on the same scale as AI to determine consumer intent for a product with only a change in keywords. Such as intent to purchase, intent to use, willingness to accept, and others. Despite the commendable contribution, these studies highlight some of their limitations. For example, Afroz et al. (2015) included attitude, subjective norms, and perceived behaviour control on EVs AI but ignored personal norms, contextual factors, and demographic characteristics. Jansson et al. (2017) examined the influence of socio-cultural factors only and excluded norms, contextual and socio-demographic variables. In comparison, Wang et al. (2018), Haustein and Jensen (2018), and Hamilton and Terblanche-Smit (2018) excluded some attitudinal and socio-cultural factors along with contextual and demographic factors. While selecting relevant socio-cultural, contextual and demographic factors and their combined impact on EVs should be considered the only equitable approach to ascertain the consumer's true intention towards EVs and the present study is based on the same approach.

2.6 Hypothesis of the study

The following hypotheses formulated based on the literature review are mentioned in Table 3.

3 Methodological approach

3.1 Sample and procedure

The survey was conducted from October 2019 to December 2019 through online surveys and face-to-interviews. The targeted population includes adult people from Delhi-NCR and major cities of Uttar Pradesh, Haryana, Bengal, and Uttarakhand who were aware of EVs (fully or partially), have the car or planning to buy one in the near future, and possess the appropriate car driving license (optional). After the eight experts evaluated the questionnaire's constructs and items on a four-point scale (1 = irrelevant, 4 = most relevant), the survey went through a few rounds of pre-tests and pilot tests to ensure that the questions were easy to understand. The purposive sampling method was adopted to include the desired people who can fulfil the earlier mentioned conditions. In the survey, respondents were asked to keep in mind that they would buy a car in the near future and asked to indicate how likely they were to buy an EV in this case? Initially, an online link for Google Forms was created and forwarded to over 1,700 people, resulting in 159 valid responses (9.35% RR) with high demographic biases. Some intercepts and limitations to the online survey approach were also noted mainly due to the English language barrier and complete absence of direct communication such as low participant interest and involvement, the abundance of non-response rates, high bias in responses and other ethical issues. Thereafter, people were approached face to face to obtain the desired

sample size and personal characteristics, which yielded an additional 99 responses and resolved the bias in the data. Data collection points included office hubs, private and central universities, higher education institutions, amusement and tourist spots, mall and shopping areas, and others. Since the population size was unknown, this study applied the purposive and convenience sampling method to collect the data. Subsequently, data cleaning and filtering were done to make it easier to understand, modify, and explore, and it was executed with the data entered in the software, i.e., MS Excel and SPSS 24v. The data collected for the study was coded and entered into MS Excel to detect mistakes, omissions, missing values, outliers, invalid or incomplete responses. None of the outliers was removed in this study unless it was a mistake because the questionnaire was close-ended, and each response had to be treated as a true response. Since omissions, missing values, and invalid or incomplete responses were not in the numbers to be considered (much less than 10% of the observations, Hair et al., 2010), most were removed from the dataset rather than replaced with the means of the construct. Statements that received negative responses were reverse coded before the data was entered into the SPSS software. The validity and multicollinearity issue between the variables was ensured with a correlation coefficient matrix. If the correlation value is under 0.7, validity is ensured. As shown in Table 2, all values were under 0.7, indicating that two sets of the concept were valid but not highly related. Moreover, for multicollinearity, tolerance (min = 0.342/max = 0.751) and VIF (min = 1,332/max = 2,929) values were also found to be under the desired range of > 0.1 and < 10, respectively. The validity of the variables was also ensured by the evaluation of experts (mentioned earlier). The graphical (histogram with normality curve, normal P-P plot, and scatter plots) and descriptive analysis were applied before the parametric tests to ensure the data normality (K-S test values: min = 0.059/max = 0.200, $p < 0.05$) and homogeneity (Levene's test values: min = 0.121/max = 0.490, $p < 0.05$).

Finally, 258 responses were selected for further tests and analysis. All items of variables were rated by the respondent on a seven-point Likert scale, except for the categorical variables, where scale 1 indicated that the respondent was 'strongly disagree' with the statements while scale 7 indicated that the respondent was 'strongly agree' with the statement. A sample description is included in Table 1.

3.2 Research design

The determinants (factors) of AI are broadly classified into three categories, i.e., attitudinal, contextual and personal characteristics and capabilities. All the factors and measuring items were discovered from the existing literature, and many questions were redeveloped and adapted to the specificity of this study after being evaluated by the experts. The survey questionnaire consisted of five sections. The 1st section included the title, purpose of the survey and other relevant information. Section 2 contains general items related to people's awareness and interest in EVs and the Indian government policy related to EVs (i.e., NEMMP). In Section 3, items related to attitudinal factors were asked. E.g., RA (adapted from Venkatesh and Davis, 2000; Hong et al., 2013), compatibility (Hong et al., 2013; Moons and Pelsmacker, 2015), WTP (Laroche et al., 2001; Cheah and Phau, 2011), EC (Kirmani and Khan, 2018; Joshi and Rahman, 2017), PBC (Moons and De Pelsmacker, 2015; Haustein and Jensen, 2018), SN (Haustein and Jensen, 2018), PN (Jansson et al., 2017; Wolf and Seebauer, 2014) and AI (Jiang, 2016 and self-developed). In section 4, items related to contextual factors were asked. For

instance, driving range (Degirmenci and Breitner, 2017). Purchase price [self-developed (Graham-row et al., 2012)], OC (Graham-Rowe et al., 2012; Lin and Wu, 2018) and GPI (Jiang, 2016). Section 5 included the items related to respondents' personal characteristics and capabilities such as age, gender, education and income.

Table 1 Demographic information of the respondents

Variables	*Frequency*	*Percentage (%)*
Gender		
Male	132	51.2
Female	126	48.8
Age (years)		
Below 18	34	13.2
Between 18 to 30	65	25.2
Between 31 to 40	47	18.2
Between 41 to 50	70	27.1
50 above	42	16.3
Education		
Up to 10th	53	20.5
12th	70	27.1
Graduate	73	28.3
Postgraduate and above	62	24.0
Annual income (HH)		
Up to 5 lakhs	102	39.5
Above 5 lakhs to 15 lakhs	111	43.0
Above 15 lakhs to 30 lakhs	37	14.3
Above 30 lakhs	8	3.1

Note: N = 258.

4 Results and discussion

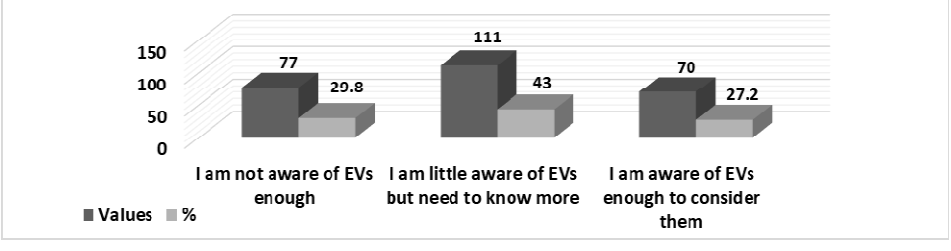
4.1 Sample description

Table 1 demonstrates that males constituted 51.2% and females 48.8% of the sample size. We have to accept that gender bias is inevitable in India as the proportion of women driving cars is much lower than men. Nevertheless, this study has tried to reduce it to a great extent. The greatest number of respondents are aged between 41 to 50 (27.1%) and 18 to 30 (25.2%) years. This study has a particular emphasis on including respondents of all personal characteristics. Based on the method of data collection, we can claim the maximum possible representativeness of the population.

4.2 Awareness level towards EVs

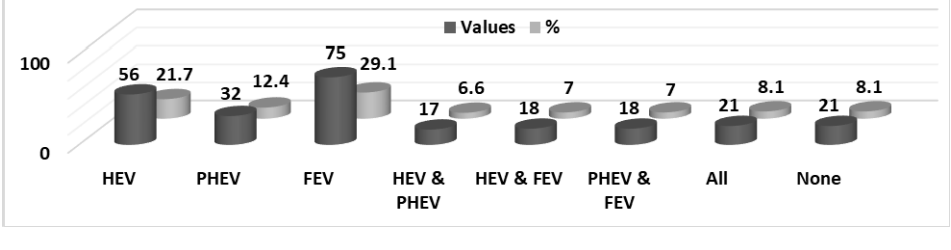
Awareness towards EV was determined based on two items. In response to the first item (i.e., 'Are you aware of EVs'), about 29.8% were not aware of EVs enough, 43% were little aware of EVs and needed to know more, and 27.1% were aware of EVs enough to consider them. See Figure 3. However, few respondents who chose the 4th option, i.e., 'I never heard of EV', were removed due to being found ineligible for this survey.

Figure 3 Awareness of EVs



Another related multiple-choice question was included to measure the specificity and depth of the first question, determining the awareness towards the type/s of EVs. FEV was ranked high by the respondents with 29.1% share, followed by HEV with 21.7% share and PHEV 12.40 share. See Figure 4 for more detail. Overall, it can be concluded that most people were unaware of any technical specifications. All they knew that it was an environmentally friendly car technology (Zhang et al., 2011; Kumar and Nisa, 2021). Krause et al. (2013) also confirmed the people unawareness of EVs. The low level of awareness of EVs among Indian people is indeed a matter of concern as the government's environmental savings policy, the future of the entire auto and allied market and the success of NEMMP depends on it.

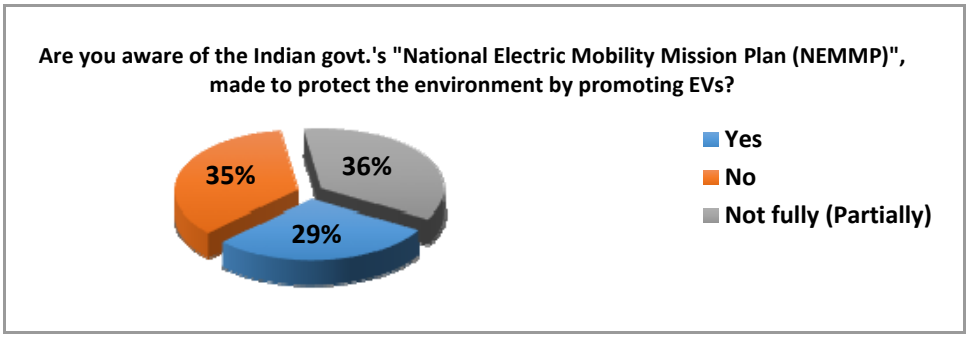
Figure 4 Awareness of only three types of EVs



4.3 Awareness towards NEMMP

As illustrated in Figure 5, only 29.4% of respondents were found to be aware of 'NEMMP' while the rest, 70.6%, were either not aware or partially aware of NEMMP.

Figure 5 Awareness towards NEMMP (see online version for colours)



Eloquently, the figures in the chart inclined towards the unawareness of the NEMMP. Similar to Diamond (2009) and Egbue and Long (2012), our study also confirms that most people still lack knowledge about the government incentives and support for EVs. Therefore, it is imperative for the Indian government to conduct a massive awareness campaign to raise public awareness about the NEMMP and EVs simultaneously and involve the automakers and marketers to make this awareness campaign ubiquitous. Consistent with the findings of Wang et al. (2013) and Thananusak et al. (2017), this study signified that the financial incentives available under the NEMMP might reduce the perceived higher price premium of EVs.

4.4 Hypothesis testing

4.4.1 Correlation coefficient

Under attitudinal factors, in Table 2, the results of correlation coefficient of the RA (r –0.286**, p < 0.01) and compatibility (r –0.393**, p < 0.01) both confirms the perfectly negative significant correlation with AI. The finding is in sharp contrast to Hong et al. (2013), who claimed a positive relationship of RA and compatibility with EV adoption. The correlation coefficient for EC and AI (r 0.631**, p < 0.01) claimed that EC has a significant positive relation with AI. Similarly, PBC and AI (r 0.231**, p < 0.01); SN and AI is (r 0.233**, p< 0.01) and PN and AI (r 0.378**, p < 0.01) showed a perfectly significant correlation.

Under contextual factors, the correlation coefficient for DR and AI (r –0.165**, p 0.004, < 0.05) and PP and AI (r –0.287**, p 0.000, < 0.05) claimed that AI is negatively correlated with DR and PP. While, the correlation coefficient for OC and AI (r = 0.096, p 0.062, > 0.05, 'ns') demonstrated no significant correlation of OC with AI. This is in line with Krupa et al. (2014) and Larson et al. (2014). Surprisingly, the study's results found a negative correlation between GPI and AI [r –0.157** (p 0.006, < 0.01)]. This contrasts with Zhang et al. (2018) and Sang and Bekhet (2015).

Table 2 Pearson's correlation coefficients matrix

	Variables	*Mean*	*SD*	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*
1	RA	3.94	1,427	-									
2	Cmpt	3.94	1,423	0.110	-								
3	EC	3.96	1,041	0.–0.105	–0.256**	-							
4	PBC	3.91	1,413	0.–0.022	–0.106	0.293**	-						
5	SN	3.96	1,493	–0.028	–0.076	0.259**	0.147*	-					
6	PN	4.01	1,414	–0.118	–0.180**	0.443**	0.256**	0.222**	-				
7	DR	3.94	1,44	0.–0.009*	0.106	–0.141*	–0.008	–0.116	–0.067	-			
8	PP	3.43	1,364	0.099	0.077	–0.177**	0.036	–0.002	–0.093	0.113	-		
9	OC	4.45	1,415	0.007	–0.051	0.019	0.047	–0.040	0.075	0.054	–0.090	-	
10	GPI	3.79	1,149	–0.008	0.118	–0.137*	–0.017	–0.139*	–0.143*	0.062	–0.067	0.057	-
11	AI	3.78	1,225	–0.286**	–0.393**	0.631**	0.231**	0.233**	0.378**	–0.165**	–0.287**	0.107	–0.157*

Notes: *$p < 0.05$; **$p < 0.01$, minimum = 1, maximum = 7. RA = relative advantage, cmpt = compatibility, EC = environmental concern, PBC = perceived behaviour control, SN = social norms, PN = personal norms, DR = driving range, PP = purchase price, OC = overall cost, GPI = govt. policy incentives, AI = adoption intention (dependent variable).

4.4.2 Further robustness tests

The correlation coefficient reveals the association between two or more variables but does not reveal the actual effect of the independent variables (IVs) on the dependent variable (DV); hence one-way ANOVA was applied to determine the actual effect of the IVs on the DVs. The AI EVs DV was converted to seven categories to meet the one-way ANOVA assumptions, with 1 indicating 'strongly disagree', 4 indicating 'neutral', and 7 indicating 'strongly agree'.

Table 3 One-way ANOVA results and hypothesis testing

ANOVA		*Hypothesis (H_A)*		*Path*	*Status (H0)*
F (df = 24, 233)	*Sig.*				
2,860	0.000	H_1	The relative advantage has a significant effect on the intention to adopt EVs.	RA-AI	Rejected
2,755	0.000	H_2	The compatibility has a significant effect on the intention to adopt EVs.	Compt-AI	Rejected
7,872	0.000	H_3	The environmental concern of the people has a significant effect on the intention to adopt EVs.	EC-AI	Rejected
2,139	0.002	H_4	People' perceived behavioural control over EVs has a significant effect on their intentions to adopt EVs.	PBC-AI	Rejected
1,453	0.085	H_5	People' social norms have a significant effect on their intention to adopt EVs.	SN-AI	Retained
2,515	0.000	H_6	Personal norms have a significant effect on their intention to adopt EVs.	PN-AI	Rejected
1,186	0.256	H_7	Driving range of EVs has a significant effect on people's intention to adopt EVs.	DR-AI	Retained
2,021	0.004	H_8	Purchase price of EVs has a significant effect on people's intention to adopt EVs.	PP-AI	Rejected
0.924	0.570	H_9	Overall cost of EVs has a significant effect on people's intention to adopt EVs.	OC-AI	Retained
2,060	0.003	H_{10}	GPI on EVs has a significant effect on people's intention to adopt EVs.	GPI-AI	Rejected

Note: sig. = p value, *p<0.05; **p<0.01.

The test results exhibited in Table 3 {F(24,233) = 2,860, p < 0.01, H1 accepted against H0} confirmed a very strong significant effect of the RA on AI. Similarly, with {F(24, 233) = 2,755, p < 0.01, H2 accepted against H0}, the test results confirmed a very significant effect of compatibility on AI. The test conducted between EC and EVs AI {F(24, 233) = 7,782, p < 0.01, H3 accepted against H0} and PBC and AI {F(24, 233) =

2,139, p < 0.01, H4 accepted against H0} also yield a very significant effect of both EC and PBC on AI. This finding is in line with the study conducted by Moons and De Pelsmacker (2015). However, despite the correlation results found to be significant, the one-way ANOVA test result revealed an insignificant effect of SN on AI {F(24, 233) = 1,453, p > 0.05, 'ns', H5 rejected in favour of H0}. In the previous studies, the same findings were affirmed by Krupa et al. (2014) and Haustein and Jensen (2018). Furthering the findings of previous studies such as Egbue and Long (2012), Skippon and Garwood (2012) and Peters et al. (2015), this study also confirmed a very significant effect of PN on AI {F(24, 233) = 2,515, p < 0.01, H6 accepted against H0}.

Regarding contextual factors, the one-way ANOVA test conducted between PP and AI {F(24, 233) = 2.021, p < 0.01, H8 accepted against H0} and GPI and AI {F(24, 233) = 2.060, p < 0.01, H10 accepted against H0} revealed a very significant effect of both PP and GPI on AI. A previous study by Lebeau et al. (2013) also confirmed the significant effect of PP and GPI on AI. However, despite a significant correlation, the one-way ANOVA test result concluded an insignificant effect of DR on AI {F(24, 233) = 1.186, p > 0.05, 'ns', H7 rejected in favour of H0}. Similar findings were confirmed in a previous study conducted by Wang et al. (2017). Eventually, with one-way ANOVA test findings {F(24, 233) = 0.924, p > 0.05, 'ns', H9 rejected in favour of H0} this study concluded an insignificant effect of OC on AI. This finding is in line with two different studies conducted by Krupa et al. (2014) and Larson et al. (2014).

Table 4 One-way ANOVA

Annual household income category (independent var.)					
	Sum of squares	*df*	*Mean square*	*F*	*Sig.*
Between groups	38,693	2	19,347	14,211	0.000
Within groups	347,152	255	1,361		
Total	385,845	257			

Post hoc – Bonferroni						
Annual household income category	*Annual household income category*	*Mean difference (I-J)*	*Std. error*	*Sig.*	*95% confidence interval*	
					Lower bound	*Upper bound*
Up to 5 lakh	Above 5 lakh to 15 lakh	–0.83893*	0.15739	0.000	–1,2182	–0.4596

Notes: *The mean difference is significant at the 0.05 level. AI = dependent variable.

4.5 t-test and one-way ANOVA

The independent t-test and one-way ANOVA were applied to determine whether personal characteristics had any influential effect on the respondents EVs AI. The t-test results (t = –1,078, p = 0.282, > 0.05, 'ns') revealed no significant impact of the gender on AI (Sierzchula et al., 2014). Further, the test results of one way ANOVA between age groups and AI (F (4,253) = 0.700; p = 0.592, > 0.05, 'ns') also concluded no significant impact (Habich-Sobiegalla, 2018). Similarly, with F (4, 253) = 0.827, p = 0.480, > 0.05, the study found no significant impact of education level on AI (Sierzchula et al., 2014; Habich-Sobiegalla, 2018). Lastly, with the one-way ANOVA test result (F (2, 255) =

14,211, $p < 0.01$), the study concluded a strong positive impact of the annual household income on AI (Sang and Bekhet, 2015 (monthly); OZ, 2017; Wang et al., 2018). See Table 4.

The Bonferroni test indicated that the two income groups that differed significantly were 'up to 5 lakh' and 'above 5 lakh to 15 lakh' with $p < 0.01$. See Table 4.

4.6 Additional findings

Apart from the dependent variable (i.e., AI of EVs), personal characteristics can significantly affect other independent factors such as attitudinal and contextual. Further tests were also carried out to detect these effects. As with gender, t-test results revealed no significant difference in the effect of the two categories (male and female) of gender on the IVs. Similarly, the one-way ANOVA test (Bonferroni) also revealed insignificant results of different categories of age and education on the IVs. This was a bit surprising, but the unexpected and insignificant results of a study are also valuable for the research world, so reporting them is the moral responsibility of all researchers. However, the test result of one-way ANOVA revealed a significant solid relation (F (7,557, 2) = 14,661; $p < 0.01$) between RA and the income categories. The Bonferroni test confirmed that the two groups differed significantly in terms of perceived advantage from EVs. The group with an income (p/a) 'above 5 lakh to 15 lakh' perceive EVs to be more advantageous than the group with an income 'up to 5 lakh'. They believe that compared with CVs, EVs will increase their job efficiency, improve fuel efficiency, and be economical in overall cost. See Table 5.

Table 5 One-way ANOVA

Relation between annual household income category (independent var.) and relative advantage (dependent var)

	Sum of squares	*df*	*Mean square*	*F*	*Sig.*
Between groups	29,231	2	14,661	7,557	0.001
Within groups	494,687	255	1,940		
Total	524.08	257			

Post hoc – Bonferroni

Annual household income category	*Annual household income category*	*Mean difference (I-J)*	*Std. error*	*Sig.*	*95% Confidence interval*	
					Lower bound	*Upper bound*
Up to 5 lakh	Above 5 lakh to 15 lakh	0.72545*	0.18788	0.000	0.2727	1.1782

Note: *. The mean difference is significant at the 0.05 level. RA = dependent variable.

Furthermore, despite insignificant test results, the means plot indicated that respondents with little knowledge of EVs showed the lowest AI EVs rather than those who opted for 'aware of EVs but not enough to consider them' and 'aware of EVs enough to consider them'. See Figure 6.

Similarly, the results of the means plot shown in Figure 7 revealed that respondents who were not aware of NEMMP showed the lowest AI EVs compared to those who were fully or partially exposed to NEMMP.

Figure 6 Relation between awareness of EVs and intention to adopt EVs

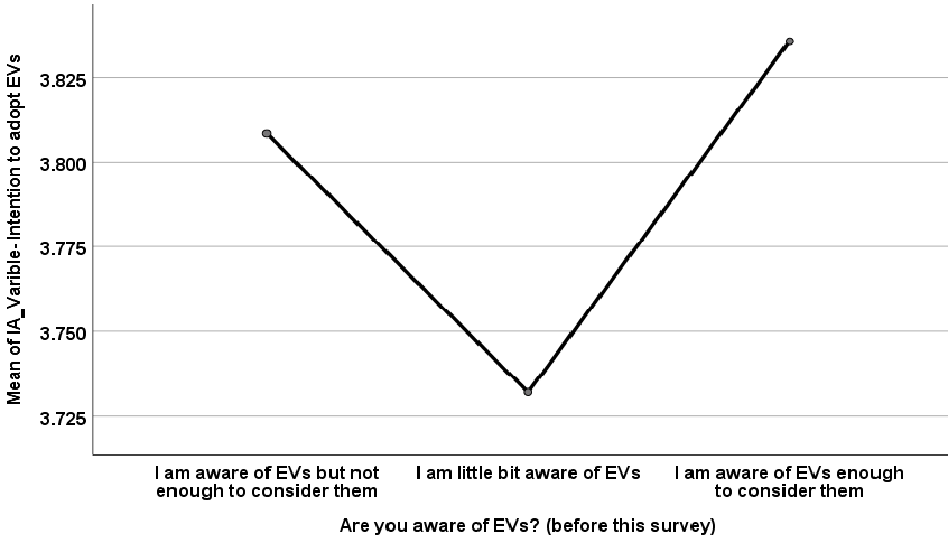
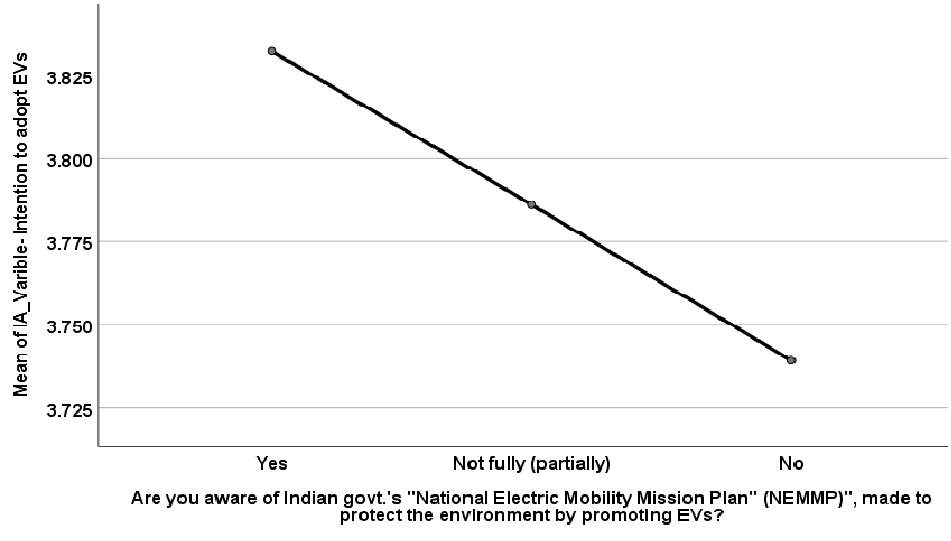


Figure 7 Relation between awareness of NEMMP and intention to adopt EVs



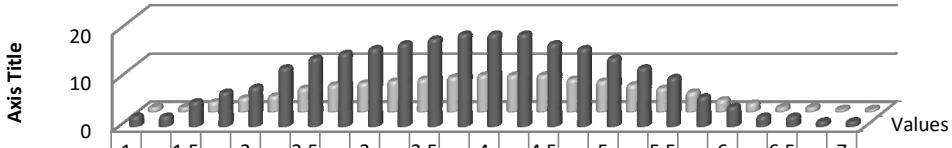
5 Conclusions and implications

The present study enables researchers, policymakers, automakers and marketers to compare and analyse the effects of attitudinal, contextual and personal characteristics on the Indian consumer eco-friendly transportation consumption, especially EVs.

The findings revealed that Indians' awareness level towards NEMMP and EVs is not satisfactory. The study also suggests that the respondents' low awareness level towards

NEMMP and EVs also affects their AI EVs as their mean score of AI EVs was calculated below neutral as 3.78%, which indicated a disagreement side (disagreement side: 52%; neutral: 28%; agreement side: 20%). See Figures 6, 7, and 8 for more detail.

Figure 8 EVs adoption intention



	1		1.5		2		2.5		3		3.5		4		4.5		5		5.5		6		6.5		7
Values	2	2	5	7	8	12	14	15	16	17	18	19	19	19	17	16	14	12	10	6	4	2	2	1	1
%	1	1	2	3	3	5	5	6	6	7	7	7	7	7	7	6	5	5	4	2	2	1	1	0	0

Considering the findings, we suggest that the Indian government should initiate a five-dimensional awareness program involving governments (state and central), vehicle manufacturers, marketers, social workers and environmental activists to make all Indians conversant of all kinds of benefits associated with NEMMP and EVs.

Under the attitudinal factors, as expected, the attitudinal factors, i.e., RA and compatibility found to have a perfectly negative correlation with the AI EVs. This may be because Indian consumers assume that EVs may not be as advantageous and compatible as CVs for some time in the currently available infrastructure and facilities. In addition, this study found a strong relationship between RA and level of income. People with higher incomes believe that, compared to CVs, EVs will increase their job efficiency, improve fuel efficiency and be economical in overall cost. Similarly, ECs showed a perfect positive correlation with the EVs AI. Since many of the respondents were from Delhi-NCR and Delhi is one of the most polluted cities globally, it is natural for them to have a serious concern about the environment. Moreover, the study's results emphasise the importance of the Theory of planned behaviour variables (i.e., perceived behaviour control and norms) in determining the AI for EVs. PN and perceived behaviour control high positive relationship with EVs AI indicates that the Indian consumers are confident about acquiring knowledge and capability about EVs, but they also consider charging of EVs as unpractical.

Regarding the contextual factors, the purchase price and even government policy incentives have a significant negative impact on consumer EVs AI. Currently, EVs models are available in the Indian market with an average driving range (around 150–200 km per charge), and even then, they do not come cheap. While EVs with a higher driving range (above 200 km per charge) are much more expensive than most consumer purchasing capacity. Surprisingly, the government policy incentives negatively impact consumer AI, but this seems to be due to the lack of awareness among people. In contrast with Ozaki and Sevastyanova (2011), Degirmenci and Breitner (2017) (PI) and Park et al. (2018) (–PI), this study conclude no significant effect of the overall cost of EVs on AI and is probably due to EV's low market share. Since Indian consumers are not familiar with this new technology, they cannot calculate the overall cost of EVs compared to traditional cars.

The personal characteristics and capabilities such as gender, age and education level were not found as the good prognosticators of EVs AI. However, this study concluded

that income was a strong predictor for the EVs AI. Respondents with high household incomes were more inclined towards adopting EVs than the respondents with low household income. In other findings, the study found no significant differences in the categories of gender, age, and education on the IVs, but different income groups had different effects on RA. The high-income groups perceive EVs to be more advantageous than the lowest income group. They believe that compared with CVs, EVs will increase their job efficiency, improve fuel efficiency, and be economical in overall cost. This study also confirmed that the level of awareness of NEMMP and EVs determines the intention of people to adopt EVs. As awareness of EVs and NEMMP increases, the AI EVs also increases.

The insights gained from the results of this research will shed more light on consumer intentions to adopt EVs and will directly help; the policymakers to mould policies and incentives as per the requirement of the Indian potential car consumer; automakers/EV engineers in customising and making the electric cars more customer-centric; and marketers to develop effective promotional and sales strategies. Evidently, price and driving range were considered significant impediments to the adoption of EVs by the Indian people. Now, since the Indian government and vehicle manufacturers are entirely dependent on foreign tie-ups for EV batteries and other devices, it is pretty challenging to make EVs available in the Indian market at present with low prices and a high driving range. Given these circumstances, adopting emotional marketing (government-backed) to make EVs AI more effective would be a good option until we are self-sufficient. We suggest that emotional marketing under the supervision of the five-dimensional awareness program (mentioned above) should be encouraged because people respond very well to the emotional part of marketing, and it often goes viral and produces surprising results. However, policy incentives were found to motivate people EVs usage intention. Hence, policymakers are advised to offer all the types of purchase and post-purchase incentives (financial and non-financial) so that EVs can reach low-income group people. Where direct subsidies encouraged them, inadequate charging infrastructure discouraged them. Still, many people were optimistic about the strengthening of charging infrastructure in the near time. The most crucial practical policy implication of EVs relates to their charging. Though EVs can be easily recharged in personal space, most people in India who can buy EVs live in unplanned colonies where parking and charging facilities are often unavailable. Therefore the development of charging facilities and infrastructure should be a top priority for the government, including private players so that implementation can be done more effectively. Secondly, electric cars are a new technological product in the Indian auto market, due to which a large number of people know less about them and therefore show less interest. This projection implies that the policymakers should promote more and more EVs in public transport so that people get used to all types of EVs. Over time, their confidence in EVs will automatically increase. The findings of this research should serve as a guide for vehicle manufacturers and marketers who intend to market EVs in the Indian auto market and encourage the government to tailor its incentives policies in a manner that best suits the potential consumer needs. If these suggestions are considered and implemented, it will directly benefit Indian potential car consumers.

5.1 Limitations

This study is also subject to some limitations, which suggest some valuable opportunities for further research. In India, EV studies are so few that they can be counted on the fingers. Further research needs to be executed in other regions of India, the rest of Asia, and Africa to reveal the diverse impact of regional differences regarding the influence of attitudinal, contextual and demographical factors. However, the focus should be more on the intentions towards EVs rather than purchase or post-purchase behaviour because, as compared with developed countries, EVs is a new car technology in these regions with a minor market share. Despite the intention, we could not gather sufficient responses of the early adopters for this study as auto companies do not disclose the details of their current buyers of EVs. The studies that will take place after EVs have gained a grip on the Indian auto market should also measure variables pertaining to purchase and post-purchase along with purchase intention. Future studies are also advised not to rely solely on the electric platform to avoid undesired and biased responses.

Undertaking

The authors take the responsibility that this paper has not been published before in any journal or presented in any other conference/seminar/symposium or submitted for consideration of any award.

References

Afroz, R., Masud, M.M., Akhtar, R., Islam, M.A. and Duasa, J.B. (2015) 'Consumer purchase intention towards environmentally friendly vehicles: an empirical investigation in Kuala Lumpur, Malaysia', *Environmental Science and Pollution Research*, Vol. 22, No. 2, pp16153–16163.

Ajzen, I. (1991) 'The theory of planned behavior', *Organizational Behavior and Human Decision Processes*, Vol. 50, No. 2, pp.179–211.

Baba, Z.U., Shafi, W.K., Haq, M.I.U. and Raina, A. (2019) 'Towards sustainable automobiles-advancements and challenges', *Progress in Industrial Ecology, an International Journal*, Vol. 13, No. 4, pp.315–331, DOI [online] https://doi.org/10.1504/PIE.2019.1028400.

Booz&co. (2011) *India Automotive Market 2020,* Chicago, USA [online] https://www.strategyand.pwc.com/media/file/Strategyand-India-Automotive-Market-2020.pdf (accessed August 2019).

Caperello, N.D. and Kurani, K.S. (2012) 'Households' stories of their encounters with a plug-in hybrid electric vehicle', *Environment and Behavior*, Vol. 44, No. 4, pp.493–508.

Cheah, I. and Phau, I. (2011) 'Attitudes towards environmentally friendly products: the influence of ecoliteracy, interpersonal influence and value orientation', *Marketing Intelligence and Planning*, Vol. 29, No. 5, pp.452–472.

Degirmenci, K. and Breitner, M.H. (2017) 'Consumer purchase intentions for electric vehicles: is green more important than price and range?', *Transportation Research Part D: Transport and Environment*, March, Vol. 51, pp.250–260.

Delang, C.O. and Cheng, W.T. (2013) 'Hong Kong people's attitudes towards electric cars', *International Journal of Electric and Hybrid Vehicles*, Vol. 5, No. 1, pp.15–27.

Diamond, D. (2009) 'The impact of government incentives for hybrid-electric vehicles: evidence from US states', *Energy Policy*, Vol. 37, No. 3, pp.972–983.

Egbue, O. and Long, S. (2012) 'Barriers to widespread adoption of electric vehicles: an analysis of consumer attitudes and perceptions', *Energy Policy*, September, Vol. 48, pp.717–729.

Gallagher, K.S. and Muehlegger, E. (2011) 'Giving green to get green? Incentives and consumer adoption of hybrid vehicle technology', *Journal of Environmental Economics and Management*, Vol. 61, No. 1, pp.1–15.

Gopidesi, R.K. and Premkartikkumar, S.R. (2019) 'Performance, emission and combustion analysis of diesel engine fuelled with emulsified biodiesel', *Progress in Industrial Ecology, an International Journal*, Vol. 13, No. 3, pp.292–301, DOI: 10.1504/PIE.2019.100907.

Graham-Rowe, E., Gardner, B., Abraham, C., Skippon, S., Dittmar, H., Hutchins, R. and Stannard, J. (2012) 'Mainstream consumers driving plug-in battery-electric and plug-in hybrid electric cars: a qualitative analysis of responses and evaluations', *Transportation Research Part A: Policy and Practice*, Vol. 46, No. 1, pp.140–153.

Habich-Sobiegalla, S., Kostka, G. and Anzinger, N. (2018) 'Electric vehicle purchase intentions of Chinese, Russian and Brazilian citizens: an international comparative study', *Journal of Cleaner Production*, 20 December, Vol. 205, pp.188–200.

Hair, J.F., Celsi, M., Ortinau, D.J. and Bush, R.P. (2010) *Essentials of Marketing Research*, Vol. 2, McGraw-Hill/Irwin, New York, NY.

Hamilton, B. and Terblanche-Smit, M. (2018) 'Consumer intention to purchase green vehicles in the South African market: a theory of planned behaviour perspective', *South African Journal of Business Management*, Vol. 49, No. 1, pp.1–7.

Haustein, S. and Jensen, A.F. (2018) 'Factors of electric vehicle adoption: a comparison of conventional and electric car users based on an extended theory of planned behavior', *International Journal of Sustainable Transportation*, Vol. 12, No. 7, pp.484–496.

Hong, Y.H., Khan, N. and Abdullah, M.M. (2013) 'The determinants of hybrid vehicle adoption: Malaysia perspective', *Australian Journal of Basic and Applied Sciences*, Vol. 7, No. 8, pp.347–454.

Jansson, J., Pettersson, T., Mannberg, A., Brännlund, R. and Lindgren, U. (2017) 'Adoption of alternative fuel vehicles: influence from neighbors, family and coworkers', *Transportation Research Part D: Transport and Environment*, Vol. 54, pp.61–73, DOI: 10.1016/j.trd.2017.04.012.

Jensen, A.F., Cherchi, E. and Mabit, S.L. (2013) 'On the stability of preferences and attitudes before and after experiencing an electric vehicle', *Transportation Research Part D: Transport and Environment*, December, Vol. 25, pp.24–32.

Jiang, S. (2016) 'Purchase intention for electric vehicles in China from a customer-value perspective', *Social Behavior and Personality: An International Journal*, Vol. 44, No. 4, pp.641–655.

Joshi, Y. and Rahman, Z. (2015) 'Factors affecting green purchase behaviour and future research directions', *International Strategic Management Review*, Vol. 3, No. 1–2, pp.128–143.

Kelkel, R. (2015) *Predicting Consumers' Intention to Purchase Fully Autonomous Driving Systems: Which Factors Drive Acceptance? Doctoral Dissertation* [online] https://repositorio.ucp.pt/bitstream/10400.14/17252/1/Reiner_Kelkel_152112329.pdf (accessed September 2019).

Khan, S. (2019) *Reinventing the Wheel: The Constant Transformation of India's Auto Sector,* Delhi ET [online] https://economictimes.indiatimes.com/small-biz/sme-sector/reinventing-the-wheel-the-constant-transformation-of-indias-auto-sector/articleshow/71916541.cms (accessed 5 December 2019)

Kim, YH. and Chung, J.E. (2011) 'Consumer purchase intention for organic personal care products', *Journal of Consumer Marketing*, Vol. 28, No. 1, pp.40–47.

Kirmani, M.D. and Khan, M.N. (2018) 'Decoding willingness of Indian consumers to pay a premium on green products', *South Asian Journal of Business Studies*, Vol. 7, No. 1, pp.73–90 [online] https://doi.org/10.1108/SAJBS-11-2016-0091.

Kotler, P., Armstrong, G., Ang, S.H., Leong, S.M., Tan, C.T. and Ho-Ming, O. (2012) *Principles of Marketing: An Asian perspective*, 3rd ed., Pearson Education South Asia, Singapore.

Krause, R.M., Carley, S.R., Lane, B.W. and Graham, J.D. (2013) 'Perception and reality: public knowledge of plug-in electric vehicles in 21 US cities', *Energy Policy*, December, Vol. 63, pp.433–440.

Krupa, J.S., Rizzo, D.M., Eppstein, M.J., Lanute, D.B., Gaalema, D.E., Lakkaraju, K. and Warrender, C.E. (2014) 'Analysis of a consumer survey on plug-in hybrid electric vehicles', *Transportation Research Part A: Policy and Practice*, June, Vol. 64, pp.14–31.

Kuberan, J. and Alagumurthi, N. (2019) 'Improving the performance and emission of CI engine using biofuel (Botryococcus)', *Progress in Industrial Ecology, an International Journal*, Vol. 13, No. 3, pp.302–313, DOI: 10.1504/PIE.2019.100908.

Kumar, S. and Nisa, S. (2021) 'Determinants of electric vehicles usage intention: an empirical study in India', *JIMS8M: The Journal of Indian Management and Strategy*, Vol. 26, No. 1, pp.12–24.

Lane, B. and Potter, S. (2007) 'The adoption of cleaner vehicles in the UK: exploring the consumer attitude-action gap', *Journal of Cleaner Production*, Vol. 15, Nos. 11–12, pp.1085–1092.

Laroche, M., Bergeron, J. and Barbaro-Forleo, G. (2001) 'Targeting consumers who are willing to pay more for environmentally friendly products', *Journal of Consumer Marketing*, Vol. 18, No. 6, pp.503–520.

Larson, P.D., Viáfara, J., Parsons, R.V. and Elias, A. (2014) 'Consumer attitudes about electric cars: pricing analysis and policy implications', *Transportation Research Part A: Policy and Practice*, November, Vol. 69, pp.299–314.

Lebeau, K., Van Mierlo, J., Lebeau, P., Mairesse, O. and Macharis, C. (2013) 'Consumer attitudes towards battery electric vehicles: a large-scale survey', *International Journal of Electric and Hybrid Vehicles*, Vol. 5, No. 1, pp.28–41.

Lim, M.K., Mak, H.Y. and Rong, Y. (2015) 'Toward mass adoption of electric vehicles: impact of the range and resale anxieties', *Manufacturing and Service Operations Management*, Vol. 17, No. 1, pp.101–119.

Lin, B. and Wu, W. (2018) 'Why people want to buy electric vehicle: an empirical study in first-tier cities of China', *Energy Policy*, January, Vol. 112, pp.233–241.

Moons, I. and De Pelsmacker, P. (2015) 'An extended decomposed theory of planned behaviour to predict the usage intention of the electric car: a multi-group comparison', *Sustainability*, Vol. 7, No. 5, pp.6212–6245.

Moons, I. and De Pelsmacker, P. (2012) 'Emotions as determinants of electric car usage intention', *Journal of Marketing Management*, Vol. 28, Nos. 3–4, pp.195–237.

Nayum, A., Klöckner, C.A. and Prugsamatz, S. (2013) 'Influences of car type class and carbon dioxide emission levels on purchases of new cars: a retrospective analysis of car purchases in Norway', *Transportation Research Part A: Policy and Practice*, Vol. 48, pp.96–108, DOI: 10.1016/j.tra.2012.10.009.

ÖZ, S.B. (2017) *The Factors Influencing the Electric Vehicle Buying Intentions in the Netherlands*, Master thesis submitted to Saxton University of Applied Science, Citation and Full Text [online] https://www.researchgate.net/publication/322476526_The_FactorsInfluencing_the_Electric_VehiclBuying_Intentionsin_the_Netherlands (accessed September 2019).

Ozaki, R. and Sevastyanova, K. (2011) 'Going hybrid: an analysis of consumer purchase motivations', *Energy Policy*, Vol. 39, No. 5, pp.2217–2227, DOI: 10.1016/j.enpol.2010.04.024.

Park, E., Lim, J. and Cho, Y. (2018) 'Understanding the emergence and social acceptance of electric vehicles as next-generation models for the automobile industry', *Sustainability*, Vol. 10, No. 3, p.662.

Peters, A., de Haan, P. and Scholz, R.W. (2015) 'Understanding car-buying behavior: psychological determinants of energy efficiency and practical implications', *International Journal of Sustainable Transportation*, Vol. 9, No. 1, pp.59–72.

Potoglou, D. and Kanaroglou, P.S. (2007) 'Household demand and willingness to pay for clean vehicles', *Transportation Research Part D: Transport and Environment*, Vol. 12, No. 4, pp.264–274.

Rezvani, Z., Jansson, J. and Bodin, J. (2015) 'Advances in consumer electric vehicle adoption research: a review and research agenda', *Transportation Research Part D: Transport and Environment*, January, Vol. 34, pp.122–136.

Sang, Y.N. and Bekhet, H.A. (2015) 'Modelling electric vehicle usage intentions: an empirical study in Malaysia', *Journal of Cleaner Production*, 1 April, Vol. 92, pp.75–83.

Schwanen, T., Banister, D. and Anable, J. (2011) 'Scientific research about climate change mitigation in transport: a critical review', *Transportation Research Part A: Policy and Practice*, Vol. 45, No. 10, pp.993–1006.

Schwartz, S.H. (1977) 'Normative influences on altruism', in *Advances in Experimental Social Psychology*, Vol. 10, pp.221–279, Academic Press, DOI: 10.1016/S0065-2601(08)60358-5.

Sierzchula, W., Bakker, S., Maat, K. and Van Wee, B. (2014) 'The influence of financial incentives and other socio-economic factors on electric vehicle adoption', *Energy Policy*, May, Vol. 68, pp.183–194.

Singh S. (2017) 'Electric vehicles project FAME moved to Niti Aayog', *Economic Times* [online] http://economictimes.indiatimes.com/articleshow/59224270.cms?utm_source (accessed August 2017).

Skippon, S. and Garwood, M. (2011) 'Responses to battery electric vehicles: UK consumer attitudes and attributions of symbolic meaning following direct experience to reduce psychological distance', *Transportation Research Part D: Transport and Environment*, Vol. 16, No. 7, pp.525–531.

Stern, P. (2000) 'New environmental theories: toward a coherent theory of environmentally significant behavior', *Journal of Social Issues*, Vol. 56, No. 3, pp.407–424, DOI: 10.1111/0022-4537.00175.

Thananusak, T., Rakthin, S., Tavewatanaphan, T. and Punnakitikashem, P. (2017) 'Factors affecting the intention to buy electric vehicles: empirical evidence from Thailand', *Int. J. Electr. Hybrid Veh.*, Vol. 9, No. 4, pp.361–381.

Venkatesh, V. and Davis, F.D. (2000) 'A theoretical extension of the technology acceptance model: four longitudinal field studies', *Management Science*, Vol. 46, No. 2, pp.186–204.

Vokas, G.A., Anastasiadis, A.G., Kondylis, G.P. and Polyzakis, A. (2019) 'Effects of different charging and discharging strategies of electric vehicles under various pricing policies in a smart microgrid', *Progress in Industrial Ecology, an International Journal*, Vol. 13, No. 2, pp.144–162, DOI [online] https://doi.org/10.1504/PIE.2019.099356.

Wang, N., Tang, L. and Pan, H. (2018) 'Analysis of public acceptance of electric vehicles: an empirical study in Shanghai', *Technological Forecasting and Social Change*, January, Vol. 126, pp.284–291.

Wang, Z., Wang, C. and Hao, Y. (2013) 'Influencing factors of private purchasing intentions of new energy vehicles in China', *Journal of Renewable and Sustainable Energy*, Vol. 5, No. 6, p.63133.

Wang, Z., Zhao, C., Yin, J. and Zhang, B. (2017) 'Purchasing intentions of Chinese citizens on new energy vehicles: how should one respond to current preferential policy?', *Journal of Cleaner Production*, 10 September, Vol. 161, pp.1000–1010.

Wolf, A. and Seebauer, S. (2014) 'Technology adoption of electric bicycles: a survey among early adopters', *Transportation Research Part A: Policy and Practice*, November, Vol. 69, pp.196–211.

Wu, G., Inderbitzin, A. and Bening, C. (2015) 'Total cost of ownership of electric vehicles compared to conventional vehicles: a probabilistic analysis and projection cross market segments', *EnergyPolicy*, May, Vol. 80, pp.196–214.

Zhang, H., Song, X., Xia, T., Yuan, M., Fan, Z., Shibasaki, R. and Liang, Y. (2018) 'Battery electric vehicles in Japan: human mobile behavior based adoption potential analysis and policy target response', *Applied Energy*, 15 June, Vol. 220, pp.527–535.

Zhang, Y., Yu, Y. and Zou, B. (2011) 'Analyzing public awareness and acceptance of alternative fuel vehicles in China: the case of EV', *Energy Policy*, Vol. 39, No. 11, pp.7015–7024, DOI: 10.1016/j.enpol.2011.07.055.

Abbreviations

Adoption intention (AI), conventional vehicles (CVs), driving range (DR), electric vehicles/cars (EVs), environmental concerns (EC), govt. policy incentives (GPI), overall cost (OC), perceived behaviour control (PBC), PN, potential car consumer (PCC), purchase price (PP), relative advantage (RA) and social norms (SN).