



Consumer adoption intention for electric vehicles: Insights and evidence from Indian sustainable transportation

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ABSTRACT

The study aims to operationalize and test the extended 'Technology Acceptance Model' (TAM) with perceived risk and financial incentives policy based on the integrative approach of 'beliefs-attitude-intention' in order to understand and predict consumers' intention to adopt electric vehicles (EVs). The research model also seeks to examine the mediating role of attitude towards EVs and the moderation of financial incentives policy in the context of an emerging sustainable transportation market. The model was empirically tested by structural equation modeling using online survey from Indian respondents. The findings reveal that adoption intention for EVs is directly and indirectly influenced by the predictor variables of attitude, perceived usefulness, perceived ease of use, and perceived risk, with the moderation of financial incentives policy. All the direct hypotheses were accepted, except the relationship between perceived risk and attitude. In addition, the findings also confirm that attitude partially mediate the effects of usefulness and ease of use on the adoption intention, however, no mediating effect of attitude has been found between risk and adoption intention. The discussion and implications offer deeper insights for policymakers and marketers on promoting EVs in the direction of future research in the sustainable transportation.

1. Introduction

Transportation is becoming one of the major contributors of greenhouse gases (Larson et al., 2014; Han et al., 2017; Wang et al., 2017a). According to the report of International Energy Agency (IEA, 2016), transport sector accounts for approximately one fourth of the total global greenhouse gas emissions and this is estimated to increase from 23% to 50% by 2030. Therefore, transportation is being termed as a major obstacle in the realization of sustainable economies (Turton, 2006; Ajanovic, 2015). In light of the speculated rise in fuel demand up to 40 percent by 2035 (Sierzechula et al., 2014), use of vehicles is expected to contribute significantly to the air pollution and the greenhouse effect (Qian and Soopramanien, 2011; Egbue and Long, 2012). Conventionally, transportation has remained reliant on petroleum fuel, which is limited and poses geopolitical implications in the supply management (Turton, 2006). These coupled with various other factors have increased the need for search and scrutiny of alternative sources of

power generation. Likewise, the looming environmental concerns and the resulting trickle down effects have exponentially invigorated the debate of powering vehicles with alternative energy sources such as electricity (Jorgensen, 2008). Although it is imperative that the alternative fuel becomes a rudimentary aspect of people's mobility, its development and incorporation in the usual consumption system is dependent on the preference shown by the consumers (Chorus et al., 2013; Junquera et al., 2016).

In general, policies are seen to be aiming at tweaks and improvements in vehicle technologies and needed infrastructural requirements, the awareness and acceptance of alternative fuel is also crucial. The costs and technical considerations can affect the acceptance behaviour of customers toward electric powered vehicles (Barth et al., 2016; Wang et al., 2018c). In addition to the cost and technology related factors that have remained decisive in slower acceptance of electric vehicles among common mass, the variations of policies and measures between nations also points at the need of mutual lessons that are needed to be learnt

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(Ajanovic, 2015). Concerning this, governments across the globe have either initiated or are earnestly contemplating to implement policies concerning green automobiles (Liao et al., 2017; Ajanovic, 2015; Lane and Potter, 2007). Electric vehicles are viewed as the future drivers of automobile market (De Santiago et al., 2011) and also as an innovation that can address environmental concerns (Sierchula et al., 2014). In this regard, efforts of making electric vehicles competitive and replace conventional ones are visible in various countries. Higher prices and lower energy densities have long prevented electric vehicles from gaining competitive edge, yet inclusion of more electric vehicle models in the automobile market is rising, this is also evident as numerous manufacturers have electric run vehicles in their portfolios (Chan, 1999; De Santiago et al., 2011).

At present, India is the fifth largest automobile market in the world and is expected to become the third largest (TFE Report, 2018) with a goal of reaching 30% EV penetration by 2030 via higher electrification of vehicles (World Economic Forum, 2019). EV can dominate the Indian automobile market and leverage its positioning as zero emission mobility based on the mounting nation-wide demand (NITI Ayog, 2018), which is largely shared by small vehicles segment (two/three-wheelers) in terms of market size with a rising middle class and young population (IBEF, 2020). In a similar vein, scholars noted that adult, middle-aged, highly educated, and professional consumers express their strong pre-disposition towards EV adoption as early adopters in varied e-mobility market settings (Singh et al., 2020; Sovacool et al., 2018). Now, India has the world's largest youth population (356 million 10-24 years old) who are the innovators, creators, and leaders of the future (The Economic Times, 2014). Thus, targeting young adult and educated segments of the Indian population can play a crucial role in the EV adoption diffusion as early adopters and potential buyers for EV in the near future.

Researchers worldwide have increasingly adapted Technology Acceptance Model (TAM) driven by cognitive theories to understand consumer psyche towards adopting EVs and as an acceptance of innovative technology or green products and services in the literature on sustainable transportation usage behaviour (e.g., Chen, 2016; She et al., 2017; Wang et al., 2018b; Wu et al., 2019). However, scholars have critically argued that the classical approach of TAM, pioneered by Davis (1989) only considers the positive or advantageous factors of cognitive beliefs based on technology attributes and overlooks users' negative perceptions about loss or resistance factor in predicting such usage behaviour (Kim et al., 2008; He et al., 2018; Wang et al., 2018a). The relationship of perceived risk with attitude formation has found limited in the literature of EV preference (Wang et al., 2018b), which may be a latent impediment in EVs adoption or new technology vehicles diffusion (Zhang et al., 2019; Featherman et al., 2021). In addition, previous literature has attempted to determine the direct and positive effect of financial incentives or subsidy policy on EVs usage behaviour (Wang et al., 2018b; Hong et al., 2019). However, scant literature was found investigating this important external stimulus measure as a moderator in promoting EV adoption diffusion (Zhang et al., 2013; Kim et al., 2018), needless to say that this important stimulus largely remains understudied in the Indian mobility market.

In particular, few scholars have examined the extended or customized approach of TAM comprising both positive and negative psychological factors viz. perceived usefulness, ease of use, perceived risk, along with external component of financial supports to predict consumer intention to adopt electric vehicles (Wang et al., 2018b; Kim et al., 2018). At prima facie, no obvious study claimed the moderation of financial incentives policy in the relationship between attitude towards EV and adoption behaviour. Particularly in India, as earlier suggested, the phenomenon of EV adoption is currently in nascent stage. Based on the available literature, no such study was found till date that examined TAM and or its extensions including the measures of positive and negative beliefs to understand and predict the phenomenon of consumers' adoption intention of EV in the backdrop of Indian zero emission mobility market. Considering the inescapable issue of air pollution

and greenhouse gas emissions generated by transportation sector, the consumer adoption of electric vehicles may be a vital solution from the demand side of sustainable transportation markets like India. Hence, this empirical study endeavors to investigate the extension of TAM with internal negative measure of perceived risk and the external motive of financial incentives policy based on the integrative approach of 'beliefs-attitude-intention'. This is being done to understand consumer psyche toward EV adoption and further fill the pertinent research gap in the context of an emerging sustainable transportation market. Thus, the positive beliefs of perceived usefulness, perceived ease of use, and negative belief of perceived risk were analyzed to test the direct effects on both 'attitude towards EVs and this adoption intention using path analysis of SEM. In addition, 'attitude towards EV' was examined to play mediating role between adoption intention and its predictor variables of usefulness, ease of use, and risk, while the external stimulus factor of 'financial incentives policy' was examined as a moderator in the relationship between adoption intention and attitudes towards EVs.

The later sections offer 'theoretical background and research hypotheses' comprising of 'EV' adoption in emerging markets with brief discussion about the conceptual framework of 'TAM' and its extension followed by 'data and methodology' section under the heads of sample and data collection, and measures. Further on, the 'analysis and results' section demonstrates scale reliability and validity followed by reporting the results of direct path coefficients along with mediation and moderation effects. Finally, the 'discussion and implications' section presents the research findings followed by concluding remarks on 'limitations and future research'.

2. Theoretical background and research hypotheses

2.1. EVs adoption in India and emerging markets

The emerging economies such as China, India and Brazil are rising up to the challenge of environmental degradation and are increasing emphasis on electric vehicles (Wu and Zhang, 2017). These countries do exhibit certain similarities in the way they progress, however in the context of EV policy Brazil is yet to gain pace as its counterparts India and China (Baran and Legey, 2013). In particular, China has made its intentions clear by including more electric powered vehicles in the transportation sector. India as an emerging market presents a notable case for researchers and propagators of alternative fuels. Electric vehicles are being increasingly placed in the consideration zone by the government. The document of NITI Aayog (2018) which is a policy think tank of government of India placed EV policy at the centre. In essence it underlined India's unique position and intricate characteristics while designing any policy related to energy usage in the country. For India the document (NITI Aayog, 2018) outlined factors including reduction of oil consumption, enablement of customer adoption, major impetus on research and development of EVs, ensuring usage by common people, reduction in pollution and gaining of global competitiveness while encouraging employment.

Swelling number of automobiles in the Indian market has led to graver challenges concerning environment, reliance on countries for fuel import and increased congestion. This has also stressed on the need of unconventional ways of fueling automobiles (Digalwar and Girdhar, 2015). To meet the challenges arising from growing vehicle traffic on Indian roads National Electric Mobility Mission Plan has emphasized on the inclusion of electric vehicles coupled with vehicles with hybrid and plug-in hybrid technology (Saxena et al., 2014). However, current state of EV inclusion in the Indian market needs further push, because as against staggering 3.4 million fossil fuel-powered cars sold in 2018, estimated three thousand were electric powered (Afonso, 2020). One recently cited bottleneck for realization of EV production goals in India has been the scarcity of lithium, a chemical needed for making cathodes and battery cells for electric cars, which has increased India's reliance on China for export of the substance (Afonso, 2020). Another factor

responsible for slower acceptance of EVs in the Indian context is connected with the charging infrastructure. A proposal to iron out such bottlenecks is presented by [Digalwar and Giridhar \(2015\)](#), wherein factors like cost, operating parameters such as stability of voltage, frequency and duration based reliability, power loss, access, and waiting times at charging stations, are proposed to be duly considered.

India is awakening to the grave challenge of environmental degradation. In doing so one crucial emphasis has been towards the electrification of rail networks and the expansion of metro rail networks to various cities throughout the country. The public bus services, however, have not been essentially comfortable, which has led to the increased dependence on personal vehicles ([Kumar and Khurana, 2019](#)), which are chiefly petrol and diesel fueled, ergo, are central to the environmental concerns. India hopes to achieve stronger goals pertaining to massive adoption of electric vehicles by 2030 ([Upadhyayula et al., 2019](#)). These targets have met with certain trepidations, whereby current rate of adoption of EVs in India has been put under scrutiny ([Shankar and Kumari, 2019](#)). However, notwithstanding the sluggish growth shown by the country's automobile sector in the financial year 2019, BS-VI (emission) norms, which are expected to get implemented in 2020, may help revive electric vehicle industry by making them more price competitive ([Narasimhan, 2019](#)). Given these arguments, the current state of EV adoption needs to go a long way from the current miniscule market share of mere one percent of total vehicle sales ([Shankar and Kumari, 2019](#)). This doesn't exclude the need of extensive research in the consumer adoption models and technology improvement in Indian market.

2.2. Technology acceptance model (TAM) and extension

Technology acceptance model (TAM) pioneered by [Davis \(1989\)](#) is one of the most popular theories of understanding consumer psychology related to acceptance of innovative technology or new products in the field of technology usage behaviour ([Zhang et al., 2013](#); [Wang et al., 2017a](#)). TAM is fundamentally based on the approach of 'beliefs-attitude-intention', derived and extended from the classical cognitive theories like [Fishbein and Ajzen, \(1975\)](#)'s theory of reasoned action (TRA), [Ajzen and Fishbein \(1980\)](#)'s theory of planned behaviour (TPB), [Bhat-tacherjee \(2001\)](#)'s expectation–confirmation theory, and rational choice theory ([Venkatesh and Davis 2000](#); [Ajzen, 1991](#); [Chen 2016](#); [He et al., 2018](#); [Wu et al., 2019](#); [Cheng et al., 2019](#)). According to the classical approach of TAM, the two internal beliefs of 'perceived usefulness' and 'perceived ease of use' influence the external factors of attitude and intention as the predictor variables, which ultimately affects the technology usage behaviour ([Davis, 1989](#); [Benbasat and Barki, 2007](#); [Chen, 2016](#); [Wang et al., 2017a](#)). However, scholars have critically argued that the classical approach of TAM only considers the positive or advantageous factors of cognitive beliefs based on technology attributes and overlooks users' negative perceptions about loss or resistance to predicting such behaviour ([Kim et al., 2008](#); [Wang et al., 2018a](#)).

Concerning this phenomenon, some scholars have identified and reported that perceived risk is one of the foremost obstacles or barriers that directly or indirectly affects the usage intention of EV ([Cheng and Huang 2013](#); [Yang et al., 2016](#); [Kim et al., 2018](#); [Wang et al., 2018b](#); [He et al., 2018](#); [Cheng et al., 2019](#)). Therefore, the 'extended TAM' holds that the formation of usage attitude is fundamentally driven by two optimistic beliefs of perceived usefulness and perceived ease of use, and one pessimistic internal belief of perceived risk as the predictors of consumers' intention to adopt EV in the context of sustainable transportation ([Venkatesh and Davis, 2000](#); [Wang et al., 2018b](#); [Wang et al., 2018c](#); [Cheng et al., 2019](#)). In addition, TAM can also incorporate other factors or motives to augment its effectiveness through its extension or modification along with its two fundamental determinants viz. usefulness and ease of use by integrating other internal and external factors ([Venkatesh and Davis, 2000](#); [Wu et al., 2019](#)) such as such perceived risk, financial incentives policy or government support, trust etc.

([Zhang et al., 2019](#); [Hong et al., 2019](#)). Therefore, the present study incorporates the pessimistic variable of perceived risk and an external stimulating factor of 'financial incentives policy' to augment or extend TAM along with its two fundamental optimistic motives of usefulness and ease of use in the context of EVs adoption behaviour.

Hence, this study seeks to investigate the extension of TAM with perceived risk and financial incentives policy and verify the causal linkage of 'beliefs-attitude-intention' by employing hypothesized direct, mediating, and moderating paths using SEM in order to contribute to the existing literature on consumer psychology of EV preference. Thus, consumers' positive beliefs of perceived usefulness, perceived ease of use, and the negative belief of perceived risk were hypothesized to test the direct effects on both 'attitude towards EVs' and the adoption intention. In addition, 'attitude towards EVs' was hypothesized to play the mediating role between adoption intention and its predictor variables of usefulness, ease of use, and risk. Finally, the external inducement motive of 'financial incentives policy' was hypothesized as a moderator in the causal relationship between attitude and adoption intention, shown in [Fig. 1](#): The conceptual model.

2.3.1. Perceived usefulness

Perceived usefulness refers to the extent to which the adoption of a particular technology or system can be useful and facilitating in the products or services performance, in turn it influences favorable users' attitude toward new technology or innovative products and its usage intention ([Davis, 1989](#); [Venkatesh and Davis 2000](#); [Liao et al., 2009](#); [Wang et al., 2018b](#)). In the context of EVs adoption as eco-friendly vehicles, the psychological measure of perceived usefulness includes the following key attributes: EV is useful in alleviating CO₂ emissions and control gasoline fuel consumption, it is usefulness in reducing users' household expenditure on transportation and is also valuable in improving health quality (i.e., respiratory system), protected from air or smog pollution. Thus, the following hypotheses were postulated:

H1: Perceived usefulness has a direct and positive relationship with attitude towards EVs.

H2: Perceived usefulness has a direct and positive relationship with the adoption intention for EVs.

2.3.2. Perceived ease of use

The cognitive measure of the perceived ease of use is a subjective judgment of users about the degree to which using a particular technology could be easy and free from physical and psychological exertions, consequently, affects positively the consumers' attitude towards this technology offering and its adoption intention ([Davis, 1989](#); [Venkatesh and Davis 2000](#), [Wu et al., 2019](#)). Moreover, Researchers have reported that perceived ease of use can positively influence the perceived usefulness and thus, new technology offerings can be perceived as useful only when they are easy to adopt and suitable for the customer usage ([Wang et al., 2018b](#); [Cheng et al., 2019](#)). The notion remains that consumers are more likely to adopt new technology or its related products in their shopping choice when they perceive it to be simple and convenient to use. Likewise, this observation may be pertinent with the case of consumers' adoption of EV as innovative product offerings ([Lieven et al., 2011](#); [Wang et al., 2017a](#); [Wang et al., 2018a](#)). Hence, the following hypotheses were proposed:

H3: Perceived ease of use has a direct and positive relationship with attitude towards EVs.

H4: Perceived ease of use has a direct and positive relationship with the adoption intention for EVs.

2.3.3. Perceived risk

Perceived risk is consumers' negative psyche toward adopting new technology or innovative products, defined as users' subjective evaluation of uncertainty or anxiety and may have negative association with

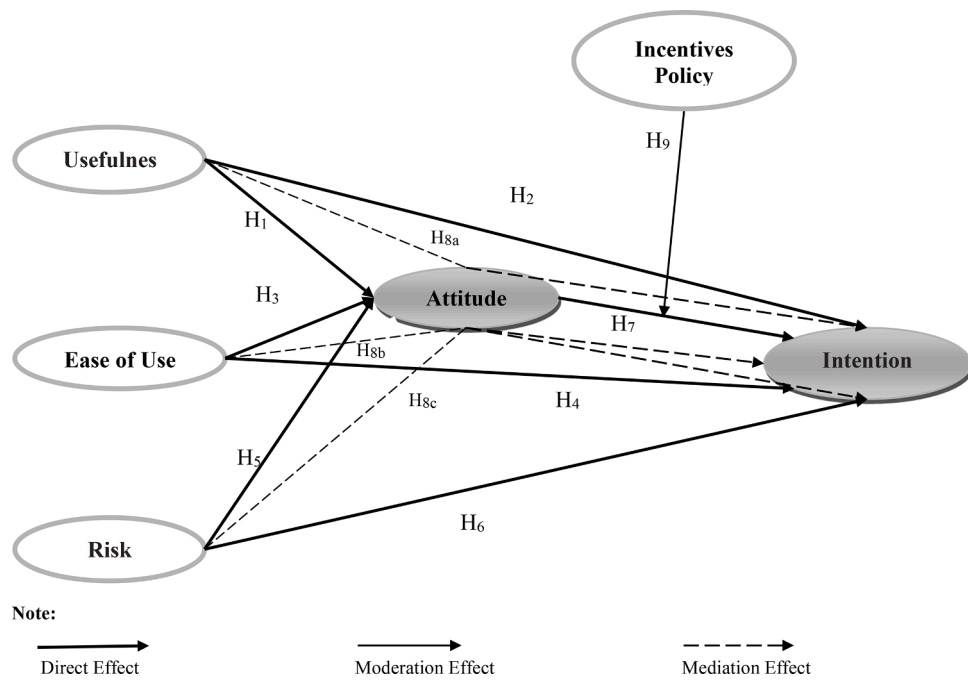


Fig. 1. : The conceptual model and hypotheses.

their decision-making approach for the adoption of EVs (Dunn et al., 1986; Kim et al., 2008; Wang et al., 2018b; Featherman, et al., 2021). Moreover, low consumers acceptance of new product or service occurs owing to their subjective expectation of loss or the potential for unpleasant consequences (Roy et al., 2017; Laroche et al., 2010). The contention is that the more the consumers perceive risks toward newer technology, the lesser is the positive value perceived by them for adopting the innovative offerings (Kim et al., 2018; Yang et al., 2016). With this viewpoint, literature suggests that users' uncertainty of innovative technology is primarily concerned with doubts or anxiety factor primarily associated with financial losses and utility risks such as uncertainty related to performance, convenience, long recharging time, charging infrastructure, and safety concern etc., when they consider to adopt new technology or buying technological products like EVs (Roselius, 1971; Featherman and Pavlou 2003; Li et al., 2017; Wang et al., 2018a; Wang et al., 2018b; Featherman, et al., 2021). The role of perceived risk is also being emphasized as a major barrier to accepting the online banking or e-shopping behaviour, reporting with its direct association with consumers' attitude and adoption intention (Roy et al., 2017; Alalwan et al., 2016; Zang et al., 2019). Hitherto, there is a dearth of studies scrutinizing the relationship of pessimistic internal belief or perceived risk with the consumer attitude toward innovative technologies, for instance the clean vehicles like EVs in the context of automobile user psychology. In a similar vein, Wang et al (2018b) unveiled the direct and negative influence of perceived risk on the attitude towards EVs, while Zhang et al (2019) reported the indirect negative effect of risk perception on attitude towards automated vehicles using TAM. Concerning this psychological measure, some scholars have analyzed and identified perceived risk as one of the foremost critical factors (i.e., obstacle or anxiety) adversely affecting the users' confidence and positive attitude of the EVs (Wang et al., 2018b), and their usage intention directly and indirectly (Cheng and Huang 2013; Yang et al., 2016; Kim, et al., 2018; Wang et al., 2018c; He et al., 2018). It can thus be argued that there lie causal associations of perceived risk with attitude and intention, and such risk perception may act as a major impediment in EV adoption. Therefore, this observation may be relevant with consumers' decision-making process for EV adoption as green-clean technology vehicles in the context of emerging mobility markets like India, where the adoption of EVs is in a nascent phase. Based on the above discourse,

the present study proposes that higher consumers risk perceptions will diminish their preferences and liking of EV (i.e., favourable attitude), and further this negative perception may unpleasantly affect their readiness to adopt in near future. Thus, the following hypotheses were proposed.

H5: Perceived risk has a direct and negative relationship with attitude towards EVs.

H6: Perceived risk has a direct and negative relationship with the adoption intention for EVs.

2.3.4. Mediating role of attitude toward EVs

Scholars have observed that a favorable attitude towards eco-friendly products lead to favorable purchase intention for such products in the context of environmental consumer psychology (e.g., Chan, 2001; Vermeir and Verbeke, 2006; Kumar et al., 2017; Jaiswal and Kant, 2018). In view of the technology acceptance framework, Ajzen and Cote (2008), and Wang et al. (2018b) have argued that consumers' attitude toward an innovative technology or new product is the key predictor of their intention to adopt such technology. Therefore, attitude is essential in understanding and predicting future behaviour related to this technology. Attitude is a favorable or unfavorable evaluation of acceptance behavior (Ajzen and Fishbein, 2005) and is derived from the user internal positive or negative beliefs towards innovative technology or new products. When consumers hold positive perceptions about a particular technology, their adoption intentions are augmented and vice versa, in turn this is more likely to translate into actual adoption behaviour towards such technology (Liu et al., 2018; Wang et al., 2018b). Thus, changing user' attitude is more likely to stimulate a desired adoption behaviour. According to TAM and its extended approach, attitude is the function of consumers favourable or unfavorable cognitive beliefs of 'perceived usefulness', and 'ease of use' and perceived risk toward EVs as new technology product (Chen, 2016; Wang et al., 2017a; He et al., 2018). In contrast, some studies have termed unfavorable cognitive belief as a risk factor in adopting EVs as newer technology and treated it as a critical obstacle or cost factor in the formation of favorable attitude towards the adoption of such technology product (Kim et al., 2008; Luo et al. 2010; Cheng and Huang 2013; Wang et al., 2018a). Additionally, EV adoption as a newer technology

depends heavily on consumer cognitive beliefs (Rezvani et al., 2015), but not on technology attributes (Egbue and Long, 2012; He et al., 2018).

Based on this, we postulate that the cognitive beliefs of 'perceived usefulness', and 'ease of use', may have an indirect positive influence on the consumers' intention to adopt EVs via the mediating role of the attitude towards these vehicles. In contrast, the internal beliefs of perceived risk may have an indirect negative effect on the adoption intention via mediation of attitude due to uncertainty or anxiety of using such innovative vehicles. The notion is that the attitude towards EV directly affects the adoption intention of such vehicle and furthermore it also leads the meditational pathway through which perceived usefulness, ease of use, and perceived risk affects the EV adoption intention. The above arguments resulted in the following hypotheses.

H7: Attitude towards EVs has a direct and positive relationship with the adoption intention.

H8a: Attitude towards EVs mediates the positive relationship between perceived usefulness and the adoption intention.

H8b: Attitude towards EVs mediates the positive relationship between perceived ease of use and the adoption intention.

H8c: Attitude towards EVs mediates the negative relationship between perceived risk and the adoption intention.

2.3.5. Moderating role of financial incentives policy

Empirical studies on EV preference have shown that higher initial purchasing price and maintenance costs are among the major obstacles in the acceptance of green technology vehicles (EVs) by the potential consumers (Heffner et al., 2007; Zhang et al., 2013; Helveston et al., 2015; Wang et al., 2017b). Additionally, the potential consumers are often price sensitive towards the adoption of EVs (Lieven et al., 2011; Wang et al., 2017a) however, they may consider it because of the lower fuel costs than the conventional vehicles (Zhang et al., 2013). The price of green-clean technology vehicles (EVs) is usually higher than that of gasoline vehicles making price an important decision-making variables for prospective or new customers in adopting innovative fuel-efficient vehicles (EVs). To cope with the issue of high price effects, the government and financial supportive agencies of industrialized and emerging economies have initiated some monetary and non-monetary benefits such as direct purchase subsidies, tax rebates in the usage of EVs, and charging infrastructure augmentation etc. in order to stimulate the demand of such zero emission vehicles in their mobility markets (Zhang et al., 2013; Klöckner et al., 2013; Bjerkkan et al., 2016; White and Sintov, 2017; Wang et al., 2017b; Kim et al., 2018). Suggestive of some contradiction to the presented context, few studies have argued that the governments' direct support of financial incentives is not as influential as expected and report that the other stimulus like performance benefits is more influential than direct financial support (Zhang et al., 2013; Li et al., 2018). Literature documenting effects of financial incentives on EVs adoption has remained conflicting, where some endorse them as favorably influencing EVs sales (Gallagher and Muehlegger, 2007; Beresteanu and Li, 2011; Lane and Potter, 2007), others differ from that viewpoint (Wang et al., 2017a; Kim et al., 2018).

Although studies have attempted to confirm the direct positive effect of financial incentives policy on EV adoption diffusion (Wang et al., 2018b; Hong et al., 2019), a little attention has been paid to explore the moderating role of such incentive mechanisms as an external motive in encouraging EV adoption. In line with this, it may be argued that limited attention has been paid the moderating role of incentive policies in influencing pro-environmental behavior (Hong et al., 2019; Fu et al., 2020). At prima facie, no obvious study considered the moderation of this incentive mechanism in the relationship between users' attitude towards EV or related eco-friendly vehicles and their adoption behaviour. Additionally, such an important phenomenon largely remains understudied in the Indian mobility market.

Furthermore, the prices of EV are considerably higher than the

conventional automobiles. Thus, the favorable attitude towards EV can drive intentions to adopt or prefer such vehicles, when favorable financial incentives or subsidies are offered to consumers who are willing to adopt or buy it in near future, as well as to the existing EV users to maintain EVs. Therefore, the measure of financial incentives policy may act as an important stimulus to promoting EV diffusion, and may affect the strength or direction of the relationship between consumers' attitude towards EV and their readiness to adopt caused by the moderation of this external stimulus. Based on the mentioned discourse, this empirical study is first to address the essential research gap by analyzing the moderating effect of financial benefits policy on the relationship between adoption intentions for EVs and its fundamental predictor of attitude, particularly in the backdrop of emerging zero-emission mobility market. Thus, the arguments lead to the postulation of the following hypothesis.

H9: Financial incentives policy moderates positively the relationship between attitude towards EVs and the adoption intention.

3. Data and methodology

3.1. Sample and data collection

The current study is based on the cross-sectional approach of online survey strategy. To test the hypotheses, an online questionnaire was developed to collect the responses from young and educated participants in the target population of India. For this, students enrolled in graduation, post-graduation and doctorate programs ranging from social science, science and humanity disciplines from the various colleges and universities in the National capital territory of Delhi (NCT) were selected as the sample of the study.

The reasoning behind selecting students as the desired respondents was that they expectedly represent an informed and educated group of young adults, which implied not only a better understanding of the phenomenon of environmental sustainability (Jaiswal et al., 2021), but also the familiarity with the internet-based technology (Kumar et al., 2017; Policarpo and Aguiar, 2020). Scholars (Kumar et al., 2017; Wang et al., 2018a) have opined that students find participation in online surveys to be convenient and respond more adequately, chiefly because they are young and progressively inclined towards usage of the information technology. Besides, responses from students have also been used with a greater degree of validity by several researchers in the field of consumer psychology including EV adoption behavior (e.g., Mostafa, 2007; Lee, 2008; Cheah and Phau, 2011; Egbue and Long, 2012; Policarpo and Aguiar, 2020).

Furthermore, the primary reason for selecting National Capital Territory of Delhi (NCT) was due to the higher churning rate of working population, almost encapsulating representation from the entire country. NCT is also a special union and capital territory of India having a cosmopolitan culture, also holds reputation of being an education hub in the country's north with a population of over 16 million (Census of India, 2011). In addition, it has the highest motor vehicle ownership among all the major metropolitan cities of India (Mohan et al., 2014). About 30 % of the air pollution in NCT, which has been reported as the city with world's highest air pollution levels (India today Report, 2019), is attributable to the vehicular movement that has made the speedy adoption of zero emission electric vehicles nearby indispensable (Electric Vehicle Policy, 2018).

To administrate an online survey, the entire NCT was subdivided into four zones and the sample was selected approximately identical across all the zones to ensure its representation. The survey process involved the filling up of online questionnaire made available through social networks of academic communities to students enrolled in major colleges and universities across all zones of NCT (India) using non-probabilistic i.e., purposive sampling. Researchers have (Malhotra and Dash, 2014; Saunders et al., 2009; Yeo et al., 2017) suggested that

convenience sampling enables scholars to choose the target respondents based on their subjective judgment which is easily accessible in highly economical way. In addition, online survey method enables maximum geographical coverage of young respondents in timely and cost-effective manner (Paul et al., 2016). The language used was the Indian English as it is also the official language of India and the scale items were reversely coded. Before administering, the survey instrument was discussed with experts and scholars, and thereafter administered on 40 students to ensure appropriateness from the target population's point of view. A total of 440 responses were received and only 418 responses were found to be valid for the research purpose after screening the outliers and incompleteness. The sample size ($418 > 22 \times 15 = 330$) required for this study was found to be suitable based on the recommendation of scholars (Hair et al., 2015) for a desired level of 15 observations per item variable for applying structural equation modelling (SEM). In addition, we have also the considerable representation of both the genders, diverse educational backgrounds, and age groups, followed by assessing normality, common method bias, multicollinearity, and reliability and validity etc., to eliminate the sample error and biases. Hence, we believe that the sample size of 418 has explained adequately the study population and may have a representation of our target population of interests.

Table 1 presents the demographic profile of respondents which comprised of 236 (56.5%) male students and 182 (43.5%) female students. Education wise, majority of students 330 (78.9%) were pursuing graduation, 64 students were in Master's degree while only 24 research students were pursuing Ph.D. in various fields. In terms of families' monthly household income, 100 (23.9%) respondents answered belonging to the below income group of Rs. 25000, and 104 (24.9%) responded belonging to the income group Rs. 25001–Rs. 50000, followed by 129 (30.9%) respondents belonging to the income group Rs. 50001–Rs. 75000 and 85 (20.3%) to the above income group of Rs. 75000. Regarding the types of vehicle owned by family, 181 (43.3%) students' family owned two wheelers and 159 (38.0%) participants' family owned economy four wheeler cars (e.g., Maruti Alto, Wagon R and Hyundai i10 etc.), while 59 (14.1%) participants' family owned premium cars such as sedan and luxury cars, however only 19 (4.5%) respondents' family did not own any vehicle. With respect to numbers of vehicles owned by family, 216 (51.7%) participants owned one vehicle,

Table 1
Demographic profile of respondents (n = 418)

	Frequency	Percent
Gender		
Male	236	56.5
Female	182	43.5
Age		
18–24	357	85.4
25–34	53	12.7
35 & Above	8	1.9
Enrolled in higher education level		
Bachelor Degree	330	78.9
Master Degree	64	15.4
Ph.D.	24	5.7
Monthly household income (Rs.)		
Less than 25000	100	23.9
25001–50000	104	24.9
50001–75000	129	30.9
More than 75000	85	20.3
Types of vehicles owned in family		
Two wheelers	181	43.3
Economy four wheeler	159	38.0
Premium four wheeler	59	14.2
No vehicle owned	19	4.5
Numbers of vehicles owned in family		
One	216	51.7
Two	131	31.4
More than two	52	12.4
Zero	19	4.5

131 (31.3%) respondents owned two vehicles, while remaining 52 (12.4) responded that they had more than two vehicles in their family as shown in Table 1.

In addition, all the respondents were young adults (18 or above), which ensured that minors weren't part of the study. Thus, the young and educated segment of Indian population (NCT) was approached, as they considerably think and behave in an eco-friendly manner, and thus can be targeted by policymakers and automobile marketers as current and potential buyers of EV. In the current study, researchers believed that the target respondents were expectedly the early adopters for envisaged India's zero emission mobility market only if they perceived EVs to be of higher value as compared to the conventional/gasoline vehicles in respect to the eco-friendliness, pocket friendliness (cost effective in long term), and also in terms of the performance. Therefore, internet-based survey in NCT may broadly represent the country's youth, educated, and techno-savvy population (Saunders et al., 2009). They may be the early adopters and potential buyers of EVs in the near future. This argument corresponds with the recent studies on EV preference in the varied market contexts based on the survey of young and educated respondents (Sovacool et al., 2018; Westin et al., 2018; Habich-Sobiegalla et al. 2019).

3.2. The research measures

The survey questionnaire was divided into two parts. The first part elicited personal details of the respondents such as gender, age, qualification, household income, type of vehicle, and numbers of vehicles owned by the family. The second part was based on pre-validated measures adapted from earlier studies of green consumer psychology. This comprised of 22 items of six cognitive measures namely, perceived usefulness, perceived ease of use perceived risk, financial incentives policy, attitude towards EV adoption, and adoption intention for EV: construct items with sources reported in the annexure-1. The scales were operationalised by 7-point Likert scale where respondents were asked to share their perception towards EV adoption ranging from 'strongly disagree' (1) to 'strongly agree' (7).

4. Analysis and results

4.1. Statistical analysis: common method bias, reliability, and validity

Prior to conducting data analysis, the data were also tested to check missing responses, outliers, and normality using the suggested measures of box plot, Z-score, skewness, and kurtosis, which were found within the acceptable range based on recommended guidelines (Hair et al., 2015; Malhotra and Dash, 2014). Next, Harman's one factor test was performed to estimate the existence of common method bias (CMB). The result revealed that the all the 22 measured items were divided into six factors with eigenvalues greater than 1.0 and representing 75.587 percent of the variance. The first factor only explained 29.237 percent of the variance, which was less than the benchmark value of 50.0 percent (Harman, 1976) ensuring that data was free from common method bias (Podsakoff, et al., 2003). After getting the status of common method bias, confirmatory factor analysis was performed using AMOS with maximum likelihood estimation (MLE) to evaluate construct reliability and validity of the multi-item measurement scales. To test the reliability and validity, the loadings of all items were obtained. According to Hair et al. (2015), the loadings of items should be higher than the cut off value of 0.70. When the loading is lower than 0.70, the item should be dropped and thus, one item of perceived usefulness (0.409) was dropped as its loading was below the cut off value of 0.70. The items retained and dropped in conjunction with the loadings are shown in Table 2.

Construct reliability was used to test the internal consistency of the items of each construct. Construct validity is used to measure the level of the measurement scale that really reflects the constructs (Golafshani, 2003; Wang et al., 2016). In practice reliability of latent construct was

Table 2
Reliability and validity analysis

Construct	Item	Loading	Cronbach's alpha	Average variance extracted	Composite Reliability
Perceived ease of use (PE)	PE1	0.836	0.870	0.691	0.870
	PE2	0.834			
	PE3	0.824			
Perceived risk (PR)	PR1	0.845	0.913	0.727	0.914
	PR2	0.828			
	PR3	0.87			
	PR4	0.866			
Perceived usefulness (PU)	PU1	0.833	0.857	0.668	0.858
	PU2	0.81			
	PU3	0.808			
	PU4	0.409(dropped)			
Attitude towards EVs (AT)	AT1	0.867	0.913	0.778	0.913
	AT2	0.88			
	AT3	0.899			
Adoption intention for EVs (INT)	INT1	0.843	0.905	0.705	0.905
	INT2	0.855			
	INT3	0.85			
	INT4	0.811			
Financial incentives policy (FP)	FP1	0.789	0.843	0.575	0.844
	FP2	0.75			
	FP3	0.761			
	FP4	0.733			

Note: All loadings are significant at 0.001 level.

Measurement model fit summary: (Chi square/df=1.47, GFI=0.945, AGFI=0.926, IFI=0.985, NFI=0.954, CFI=0.985, RMSEA=0.034).

tested via Cronbach's α coefficients and composite reliability. Table-2 demonstrates the alpha value of all the construct range from 0.843 to 0.913, which were above the threshold of 0.70, as recommended by [Malhotra and Dash \(2014\)](#). Thus, construct reliability of latent constructs was found to be reasonably good. After testing reliability of the constructs, next is to assess convergent validity and discriminant validity. Convergent validity of each construct was verified by using factor loading and average variance extracted (AVE) empirically suggested by [Hair et al. 2015](#). Average variance extracted (AVE) which were calculated as per the procedure suggested by [Hair et al. \(2015\)](#) were found within the acceptable range of 0.575 and 0.778 whereas standardized loadings of all measurement items, as presented in [Table 2](#), were beyond the suggested cut-off of 0.60. As shown in [Table 3](#), the square root of AVE of each construct was found to be larger than the squared correlation between the constructs, thus confirming the adequacy of discriminant validity ([Fornell and Larcker, 1981; Hair et al., 2015](#)). Thus, it can be concluded that the measurement model achieved adequate reliability and validity.

In addition, multicollinearity assessment was done by using variation inflation factor (VIF) value of all the measured constructs which were ranged from 1.085 to 1.606 found to be within the acceptance cut off between 0.20 and 5 ([Hair et al., 2015](#)). Thus, this result established that there was no multicollinearity among the constructs in the model. In the similar vein, measurement model fit was also tested. The model fit was tested using multiple indicators and found to be fit and satisfactory within the acceptable limit recommended by [Hair et al. \(2015\)](#) (Chi square/df = 1.47, GFI = 0.945, AGFI = 0.926, IFI = 0.985, NFI = 0.954, CFI = 0.985, RMSEA = 0.034).

Table 3
Results of discriminate validity

	INT	PU	PR	PE	AT	FP
INT	0.840					
PU	0.502	0.817				
PR	-0.232	-0.163	0.852			
PE	0.451	0.419	-0.347	0.831		
AT	0.391	0.227	-0.018	0.291	0.882	
FP	0.517	0.443	-0.354	0.429	0.324	0.759

Note: The diagonal bold elements are the square roots of AVEs, and the off-diagonal elements are the correlations among constructs.

4.2. The structural model

After ensuring the satisfactory model fit of the measurement model, the structural equation model was estimated using path analysis. Path coefficients of beta weight (β) show the strength of relationships between the dependent and independent variables and the (R^2) value-amount of variance explained by independent variables. Both, the R^2 and the path coefficients indicate how well the model is performing ([Nath et al., 2013](#)). The estimation of the structural model was done using AMOS using maximum likelihood estimate (MLE). The test of overall fit of the model depend on goodness-of-fit index (GFI), incremental fit index (IFI), normed fit index (NFI) and comparative fit index (CFI) and root mean square error of approximation (RMSEA) ([Malhotra and Dash, 2014](#)).

Table-4 demonstrates the research model (extended TAM²) fit summary, which was found to be satisfactory results meeting the recommended levels, i.e., Chi square/df = 1.53, GFI = 0.954, AGFI= 0.935, IFI = 0.987, NFI = 0.965, CFI= 0.987, RMSEA= 0.036 ([Hair et al., 2015; Malhotra and Dash, 2014](#)). In the similar vein, the proportion of variance explained by R^2 that represents the explanatory power of the research model. The R^2 value for the endogenous variable of adoption intention for EVs was 0.483 (i.e., all the predictor variables jointly explained for 48.3% of total variance of adoption intention). Thus, it confirmed the strong explanatory power for extended TAM² (the

Table 4
Results of goodness fit statistics of the models

Goodness of fit statistics & R^2	TAM ¹	Extended TAM ²	Cut-off values
CMIN/DF (χ^2 /df)	1.49	1.53	>1 & <5
Goodness of Fit Index (GFI)	0.968	0.954	≥ 0.90
Adjusted Goodness of Fit Index (AGFI)	0.951	0.935	≥ 0.90
Incremental Fit Index (IFI)	0.991	0.987	≥ 0.90
Normed Fit Index (NFI)	0.974	0.965	≥ 0.90
Comparative Fit Index (CFI)	0.991	0.987	≥ 0.90
Root mean square error of approximation (RMSEA)	0.035	0.036	≤ 0.08
R^2 (Adjusted)	0.435	0.483	

Note: Cut-off value recommended by [Hair, et al \(2015\)](#), Kline (2015).

TAM¹ = comprises of PU, PE, AT, & INT. Extended TAM² = comprises of PU, PE, PR, AT, FP, & INT.

research model) than its original TAM¹, which was 0.435, reported in Table 4.

4.2.1. Direct effects

After getting the satisfactory results of structural model fit, research hypotheses were examined to find the impact of variables. The results of the path analysis are examined with the help of coefficient (β) and the p value shown in Table 5.

The results of path analysis of SEM revealed that perceived usefulness (H_2 ; $\beta = 0.346$, $p < 0.01$) had the greatest positive significant impact on adoption intention followed by EV attitude towards EVs (H_7 ; $\beta = 0.254$, $p < 0.01$) and perceived ease of use (H_4 ; $\beta = 0.196$, $p < 0.01$) as the key antecedents of consumers' intention to adopt EVs. Meanwhile, the direct path between perceived risk and adoption intention (H_6 ; $\beta = -0.103$, $p < 0.05$) was found significant, which confirmed an inverse direct relationship with adoption intention of EVs, thus H_6 was accepted. Additionally, the path between perceived ease of use and attitude towards EVs (H_3 ; $\beta = 0.270$, $p < 0.001$) was found to be higher positive and significant followed by perceived usefulness (H_1 ; $\beta = 0.129$, $p < 0.05$). While perceived risk ($\beta = 0.096$) was insignificant and reported no inverse hypothesized relationship with attitude towards EVs, thus H_5 was not accepted. Therefore, the findings of this study reported that all the direct hypothesized relationships were accepted (H_1 , H_2 , H_3 , H_4 , H_6 , & H_7) except the negative hypothesized relationship between perceived risk and adoption intention, thus the H_5 was not supported the research model.

4.2.2. Mediating effects of attitude towards EVs

Table-6 presents the results of mediating effect of attitude towards adoption intention of EVs. The analysis of mediation effect was carried out according to the three steps procedure suggested by Baron and Kenny (1986), which is widely accepted in consumer psychology including social sciences research. This method was increasingly adopted by recent scholars to test mediation in the research domain of EV adoption or EV buying behaviour (Wang et al., 2016; He et al., 2018; Eccarius and Lu, 2020). In the first step, the independent variable should have a significant influence on the dependent variable. In the second step, the independent variable should significantly influence the mediator. In the last step, if the mediator significantly influence the dependent variable while the independent variable does not significantly influence the dependent variable, this confirms the condition of full mediation. If, both the independent variable and the mediator significantly influence the dependent variable, this indicates the satisfying condition of partial mediation (He et al., 2018). Furthermore, it is worth noting that if the independent variable does not significantly influence the dependent variable or does not significantly influence the mediator in the first or second step, thus, no mediation effect can be confirmed (Wang et al., 2016).

As Table 6 shown that the mediation results confirmed that attitude towards EVs partially mediated both perceived usefulness and perceive ease of use on adoption intention of EVs positively based on the recommended procedure of Baron and Kenny (1986) in the present model. Thus, H_8a and H_8b hypotheses were accepted. However, the pessimistic

measure of perceived risk was insignificant in the second stage, indicating no mediation effect of attitude in the relationship between risk and intention, thus, H_8c hypothesis was not accepted. Therefore, H_8 was partly supported in the model with confirming partially mediation of 'attitude' between the effects of two optimistic internal beliefs namely, 'usefulness' and 'ease of use' on 'adoption intention'.

4.2.3. Moderating effect of financial incentives policy

In the present study, the external stimulus measure of financial incentives policy (FP) was employed to moderate the relationship between attitude towards EVs and adoption intention of EVs. Table 7 summarizes the result of moderating effect of financial incentives policy (H_9). To test this underlying moderation, multi-group analysis (MGA) was performed using AMOS software based on the recommended procedures of Chin (2000), Soper (2021). As per suggested procedure, mean of the sample was used to split into two groups such as, higher level of FP ($N_1 = 259$) and lower level of FP ($N_2 = 159$) for making the comparison between their regression coefficients using t-value (Singh et al., 2020; Soper, 2021). The compared results confirmed that there was a significant difference ($t = 3.121$, $p < 0.001$) between the coefficients of higher level of FP ($\beta = 0.263$, $p < 0.001$) and lower level of FP ($\beta = 0.489$, $p < 0.001$) shown in Table 7. Hypothesis (H_9) was accepted. Thus, the results of moderation elucidate that consumers with a high level of financial incentives policy ($\beta = 0.263$) exhibit a lower intensity in the hypothesized relationship between EVs attitude and the adoption intention, than consumers with a low level of incentives policy ($\beta = 0.489$). Therefore, the hypothesis (H_9) supports the moderation of financial incentives policy in the proposed model, in line with the previous findings (Kim et al., 2018). Hence, the findings contribute immensely to the existing body of knowledge as extended TAM by filling this important research gap of the EV adoption framework in the emerging sustainable mobility market.

5. Discussion and implications

To confront with the challenge of air pollution caused by transportation sector, adoption of electric vehicles (EVs) has arguably become a coveted solution from the demand side of mobility market. An increased sense of urgency in promoting consumers' adoption of EVs by policymakers and marketers is warranted. The present study employed the extended approach of TAM with the measures of perceived risk and financial incentives policy to understand and capture the phenomenon of consumers' adoption intention of EVs in the context of an emerging zero emission mobility market in line with the global agenda of zero or no emission transportation. The research endeavored to explore the direct, mediated, and moderated relationships in order to fill the research gap in the context of consumer psychology of EV adoption. The path analysis was performed to test direct hypothesized relationships in the research model based on the framework of 'beliefs-attitude-intention' derived from cognitive theories, while mediation and moderation approaches were used to predict indirect effects. Moreover, influence of cognitive measures of perceived usefulness, perceived ease of use, and perceived risk were analyzed on both attitude towards EVs and the adoption intention of EVs followed by the indirect effect of cognitive measures on the endogenous variable of adoption intention via the mediating role of attitude. The external motive of financial incentives policy was also employed to test the moderation effect in the relationship between attitude and the adoption intention.

The results of direct paths revealed that perceived usefulness ($\beta = 0.346$) had the greatest significant effect on consumers' intention to adopt EVs directly as the antecedent of adoption intention followed by the measure of EVs attitude ($\beta = 0.254$), perceived ease of use ($\beta = 0.196$), and perceived risk ($\beta = -0.103$). These results are partly in line with the recent studies conducted (Wang et al., 2018b; Featherman, et al., 2021) in the emerging economies. In regard to the attitude, positive belief of perceived ease of use ($\beta = 0.270$) was found to have

Table 5
Structural model: Results of direct effects

Hypotheses	Path	Standard Coefficient	p value	Results
H_1	PU $\longrightarrow$ AT	0.129*	0.032	Accepted
H_2	PU $\longrightarrow$ INT	0.346**	0.001	Accepted
H_3	PE $\longrightarrow$ AT	0.270**	0.001	Accepted
H_4	PE $\longrightarrow$ INT	0.196**	0.001	Accepted
H_5	PR $\longrightarrow$ AT	0.096ns	0.083	Rejected
H_6	PR $\longrightarrow$ INT	-0.103*	0.033	Accepted
H_7	AT $\longrightarrow$ INT	0.254**	0.001	Accepted

Note: *, ** The coefficient is significant at 0.05, and 0.01 levels, respectively. ns = not significant.

Table 6

Results of mediating effects of attitude towards EVs

Hypotheses	IV	M	DV	IV -> DV	IV -> M	IV + M -> DV IV -> DV	M -> DV	Mediation role
H _{8a}	PU	AT	INT	0.521**	0.241**	0.453**	0.282**	Partial
H _{8b}	PE	AT	INT	0.476**	0.293**	0.395**	0.276**	Partial
H _{8c}	PR	AT	INT	-0.246**	-0.028 ^{ns}	-0.235**	0.385**	No Mediation

Note: IV = independent variable, M = mediator, DV=dependent variable, ** p<0.01, ns = not sig.

Table 7

Moderating effect of financial incentives policy

H ₉	Effect	High financial incentives policy (N1 = 259)			Low financial incentives policy (N2=159)			t-value	Difference
		Beta	S.E.	p-value	Beta	S.E.	p-value		
	AT—> INT	0.263	0.036	0.000	0.489	0.053	0.000	3.121**	Yes

Note: ** p<0.01, Estimation was done using the procedure suggested by Chin (2000), Soper (2021) for performing multi-group analysis.

$$\text{based on formulation } t = \frac{b_1 - b_2}{\sqrt{S_{b1}^2 + S_{b2}^2}}, df = n_1 + n_2 - 4$$

Where Beta denotes regression weights and S.E. is the standard error of the path in the structural model.

greatest positive influence on consumers' EV attitude followed by perceived usefulness ($\beta = 0.129$). Whilst the measure of perceived risk was not significantly related with attitude ($\beta = 0.096$). Thus, all the direct hypotheses were accepted except the hypothesized relationship between perceived risk and attitude (H₅).

In the view of cognitive behavioral framework, the study also confirmed that the sum of positive and negative beliefs or perceptions such as usefulness, ease of use, and risk were the predictor variables of EV attitude and adoption intention. This finding is congruent with some recent studies (Wang et al., 2018b; Wu et al., 2019), particularly, in the context of emerging EVs markets. In the similar vein, the findings also pointed out that perceived risk was negatively influence the consumers' intention to adopt EVs. Thus, it suggested that uncertainty or negative perceptions of consumers does certainly affect their decision making choice for the usage intention of EV in the Indian mobility market, and thus, validates, to certain degree, the finding of Featherman, et al. (2021). These results are partly in line with the recent studies (Wang et al., 2018b) conducted in the emerging transportation markets.

The findings of this research also explored that attitude towards EVs was employed as the mediating variable between adoption intention and its predictor variables of usefulness, ease of use and risk based on 'beliefs-attitude-intention' approach in order to estimate its indirect effect via the mediator. EV attitude partially mediated the effect of perceived usefulness and perceived ease of use on consumers' adoption intention. However, the attitude was not found to be mediating the relationship between perceived risk and intention. H8 was partly supported in the model. Thus, the study confirms that attitude is the fundamental antecedent of the adoption intention both directly and indirectly corroborating with the similar studies in past (Degirmenci and Breitner, 2017; Wang et al., 2018b; Policarpo and Aguiar, 2020).

Meanwhile, the moderating effect of external motive of financial incentives policy was positively significant in the relationship between the attitude toward EV and the adoption intention. Thus, the hypothesis (H₉) supports the moderation of this important external stimulus in the proposed model, part in line with the previous findings (Kim et al., 2018; Fu, et al., 2020). Hence, the results of this study using the extended approach of TAM indicated that the consumers' intention to adopt EVs was directly or indirectly influenced by the predictor variables of attitude, usefulness, ease of use, and risk along with the moderating factor of financial incentives policy. This confirmed the stronger explanatory power of the existing model adopted in this study, and thus supports the studies done by other scholars (Wang et al., 2018b; Zhang et al., 2019) in the context of varied automobiles acceptance.

5.1. Theoretical implications

The research contributes to the ongoing discourse on technology acceptance by extending TAM in the light of the ongoing impetuses being offered by the propagating entities. The study documented the moderating effects of the incentives policy in the interplay of customer attitude towards electric vehicles and their intentions to adopt. Theoretically, research sheds focus on this latent association in an emerging market in the backdrop of attitude-intention gap towards electric vehicle adoption.

The study also underscores the relevance of 'beliefs-attitude-intention' framework in the EV adoption studies, which in turn impresses upon several existing theoretical frameworks. To this end, study also advances understanding on the mediating role of attitude. While support for perceived risk in driving customer attitude wasn't established, constructs of Perceived usefulness and Perceived ease of use were found to be empirically driving attitude toward EV, which further accounted for EV adoption intentions. Findings impress upon the fundamental role of attitude in terms of direct and indirect effects in the proposed framework. This along with the earlier highlighted moderation oriented findings are key insights for the researchers.

Also, of interest to researchers would be the direct effects of risks related to financial losses, safety, and performance concerns along with other inconveniences, on the adoption intentions were significant. This is a vital aspect to the theory oriented towards the emerging markets, given the inspectional stage of EV adoption in Indian context. Finally, the theory substantiated and underscored the longstanding constructs of perceived usefulness and ease of use in both directly and indirectly affecting the attitude and intentions to adopt electric vehicles.

5.2. Managerial implications

The findings also offer some valuable insights to market professionals and policymakers how the adoption of EVs can be augmented in the backdrop of an emerging transportation market. It is observed that the positive impact of ease of use on attitude toward EV is higher than perceived usefulness. The results indicate that the measure of perceived ease of use with usefulness, perform vital role in the formation of favorable attitude towards adopting green vehicles as new technology, meaning that when consumers perceive EVs to be useful and simple to use, they are more likely to adopt it, which remains consistent with prior studies (Wu et al., 2019; Wang et al., 2018b). Moreover, the consumers' pessimistic belief of 'risk' was found to have a negative significant relationship with adopting EVs, treated as uncertainty or resistant factor

to some extent with their pro-usage of these vehicles. This observation corresponds to some extent with findings noted by Wang et al. (2018b), Featherman, et al. (2021), which indicates that such an anxious belief of potential consumers would adversely translate into their EV preference, when they feel to adopt or continue this. Thus, the finding is essential to let manufactures and policymakers recognize their responsibility in reducing the risk or loss factors related to EV performance, charging facilities, and infrastructure in the Indian consumer mobility market so that the prospective consumers can adopt EVs as preferred vehicles without any hesitation akin to gasoline vehicles' performance and expediency.

The result of moderating effect of financial incentives policy indicates that the government financial support may have an influential role in terms of subsidies, tax rebate in purchasing or using EV etc. in stimulating the demand, which affect indirectly as a third party (Government) support system, consumers' negative psyche or anxiety related to high price and cost bearing of maintenance of such vehicles compared to gasoline vehicles. For a country like India the need of creativity in making EVs dominant has been quintessentially stressed, to the extent that the direct subsidies aren't seen as sustainable solutions, rather tradable auto-emission coupons, or credits dependent on the levels of CO₂ emission is being suggested as a way forward (NITI Aayog, 2018).

In addition, the sample of this study is related to young adults (18 or above), which represents a well-educated segment of the Indian population. India is home to one of the youngest populations in the world. This has garnered a colloquial reference for the country- 'YOUNGISTAN' in the popular media. This portmanteau word roughly translates into 'place of the young', encapsulating this generation's nimble expectations, swift adopting behaviour towards the newer innovative technologies, and their growing concern and interest in eco-friendly aspects. This large portion of the population is often targeted by the policymakers and marketers alike who acknowledge them as prospective consumers of EVs. Therefore, the authors too believe these participants to be the early adopters of EV in Indian zero emission mobility market because they perceive EVs to be of higher value as compared to the conventional vehicles with respect to reducing air pollution (carbon emissions) and long term cost effectiveness.

At present the world is being overwhelmed by the pandemic Covid-19 and as a result India too is experiencing the lockdown. In the shadow of this unfortunate event, one silver lining has been the improved ecosystem offering better air quality due to the ongoing lock down, which has almost stopped the major chunk of transportation across India. Some crucial lessons can be taken from the positive outcome of lockdown, one could be the adoption of EV as zero emission transport model, which can play a vital role in becoming an enduring solution to the looming problem of air pollution. Going forward, to aid such desired transformation in mobility, policymakers and marketers would have to address the fundamental issues related to charging infrastructure, price, passive benefits, and so on to promote EV adoption. Perhaps this is the right time when all the stakeholders promote EVs as an eco-friendly and clean technology product in the pursuit of national agenda of Zero

emission mobility by 2030.

6. Conclusions and future research

The study aimed to propose and test technology acceptance model with financial incentives policy as a moderator to predict adoption intention of electric vehicles in Indian market. Further on, the study also evaluated the association of perceived risk with attitude in the backdrop of the EV acceptance theory. An important contribution of the research has been the moderating role played by the financial incentives policy in the relationship between attitude held by customers and intentions displayed towards EV adoption. This way the considered model tested the extended framework of TAM including its fundamental positive and negative motives to adopt EVs along with incorporating financial incentives policy as an external stimulus factor. The paper also distinctively explored the mediation of attitude between the relationship of its key antecedents including positive and negative internal beliefs and their fundamental consequence of adoption intention. The proposed model is based on the 'beliefs-attitude-intention' framework, thus operationalised, and tested for direct, mediation and moderation effects.

Although the research model endeavours to propose significant contribution in the existing literature for understanding the consumer psyche for the usage of EV and also offers some interesting findings for policymakers and manufacturers in the context of emerging mobility market, some limitations have been acknowledged in the direction of possible future research. The sample in the study was comprised of students from National Capital Territory's universities and colleges, who are relatively young and educated, but this may restrict the generalizability of the findings. While young and educated people are receptive to prefer innovative technology products or services like EVs and battery car sharing services etc. Future studies should consider responses from more diverse samples and regions. Moreover, the research findings are based on 'beliefs-attitude-intention' derived from cognitive behavioural theories to postulate the extended TAM, however the linkage between intention and actual behaviour is still a matter of investigation. Follow-up studies should extend this model as 'attitude-intention-behaviour' approach to capture the phenomenon of actual behaviour of adopting EV, thus may provide the external validity to the research model.

CRedit authorship contribution statement

Deepak Jaiswal: Conceptualization, Writing – original draft, Methodology, Validation, Writing – review & editing. **Vikrant Kaushal:** Methodology, Writing – review & editing, Supervision. **Rishi Kant:** Formal analysis, Data curation, Validation. **Pankaj Kumar Singh:** Writing – review & editing, Supervision.

Declaration of Competing Interest

The authors declared no potential conflicts of interest with respect to the research, authorship and/or publication of this article

Annexure 1: Construct items and sources

Perceived usefulness(Wu et al., 2019, Wang et al., 2018)

- PU1 I believe that the use of electric vehicles can reduce carbon emissions and energy consumption.
- PU2 I believe that the use of electric vehicles can make me healthier.
- PU3 I believe that the use of electric vehicles can reduce my household expenditures on transportation.
- PU4 I believe that the use of electric vehicles can improve my travel efficiency.

Perceived ease of use(Wu et al., 2019)

- PE1 I think it would be simple to use electric vehicles.
- PE2 I think it would be easy for me to drive electric vehicles.
- PE3 My interaction with electric vehicles would be clear and understandable.

Perceived risk(Wang et al., 2018; He et al., 2018; Kim & Jo, 2018)

- PR1 I am afraid of suffering financial losses when using electric vehicles.

(continued on next page)

(continued)

PR2	I would not feel totally safe when I drive an electric vehicle on the road.
PR3	I worry about whether electric vehicles will really perform likewise traditional vehicles.
PR4	I worry about inconveniences when using electric vehicles (such as limited driving range, charging infrastructure and recharging time).
Attitude towards EVs adoption (Han et al., 2017; Cheng et al., 2019)	
AT1	I am interested in electric vehicles.
AT2	I like the idea of using electric vehicles.
AT3	It gives me positive feeling to adopt electric vehicles as one of my travel choices.
Financial incentive Policy (Wang et al., 2017; Wang et al., 2018; He et al., 2018)	
FP1	I think subsidy policy will encourage for adopting electric vehicles.
FP2	I think relaxation in tax policies will be helpful to adopt electric vehicles.
FP3	Subsidy and tax policies are important to me for purchasing electric vehicles.
FP4	The government should provide other incentives for using electric vehicles.
Adoption intention for EVs (Wang et al., 2017; Wang et al., 2018; He et al., 2018; Han et al., 2017)	
INT1	I am willing to adopt electric vehicles when choosing a vehicle in the near future.
INT2	I plan to adopt electric vehicles when choosing a vehicle in the near future.
INT3	I intend to adopt electric vehicles when choosing a vehicle in the near future.
INT4	I would like to recommend others to adopt electric vehicles when they planned to choose a vehicle.

Note: All the constructs were measured using by 7-point Likert scale ranging from ‘strongly disagree’ (1) to ‘strongly agree’ (7).

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