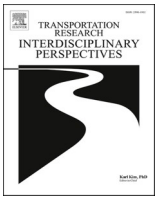
Transportation Research Interdisciplinary Perspectives 27 (2024) 101230

Contents lists available at ScienceDirect

Transportation Research Interdisciplinary Perspectives

journal homepage: www.sciencedirect.com/journal/transportation-research-interdisciplinary-perspectives



Subsidies for electric vehicles as a form of green transportation: Evidence from Indonesia

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ARTICLE INFO

Keywords:
Electric vehicles
Social dilemma theory
Tax incentives
Theory of planned behavior
Subsidies
Green transportation

ABSTRACT

A substantial body of empirical research has employed the theory of planned behavior (TPB) to investigate individual decision-making within the social context in Indonesia, which is characterized by interconnections and mutual influences. The present research is concerned with the key variables in the theory of planned behavior, namely attitudes, subjective norms, and perceived behavioral control. This investigation examines the influence of these three variables on the intention to use electric motorcycles, either directly or indiretcly, with tax incentives in the form of purchase tax subsidies acting as a moderating variable. The research findings indicate that all TPB variables have a positive impact on the intention to use electric vehicle products directly. However, the findings also demonstrated that tax incentives do not exert a significant influence on the intention to use electric vehicle products. This suggests that tax incentives function as a moderating variable and cannot operate independently to influence the intention to use electric vehicle products. These findings have a direct implications for policymakers and practitioners in the field of transportation.

1. Introduction

Perception is a significant determinant of attitudes, eliciting interest and ultimately, influencing an individual's behavior. Perceptions inform preferences (Zauberman et al., 2009) and underlie individual behavior. In this regard, the theory of planned behavior (TPB) is frequently employed as a conceptual framework for investigating the nexus between perception and individual social behavior (Ajzen, 1991a, 2011). Moreover, perceptions are shaped by the intinsic characteristics in the individual, including age, gender, educational background, income, and occupation (Mohamed et al., 2016). Additionally, social experiences (Schmalfuß et al., 2017), lifestyle, and individual personal values (Armitage and Conner, 2010a; Haustein and Jensen, 2018) exert a significant influence on the formation of perceptions. In a more specific context, individual perceptions related to purchasing behavior will be considered in light of the inherent risk and benefit factors (X. Zhang et al., 2018b).

A noteworthy phenomenon in recent times has been the growing preference for electric vehicles over conventional vehicles powered by fossil fuels. Previous research in multiple countries has indicated a rising inclination toward the adoption of electric vehicles, largely on the grounds that this category of vehicles is perceived as more environmentally benign than their conventional counterparts (Choi, Kang, and Lee, 2018; Egbue and Long, 2012; Langbroek et al., 2017; Nordlund et al., 2018). However, the findings of empirical studies examining the decision-making process behind the choice of electric vehicles appear to reinforce one another, suggesting that the necessity for greater investment plays an important role in shaping the purchasing behavior of those opting for electric vehicles.

The empirical findings in Sweden indicated that electric vehicle users are predominantly male, with a high level of educational attainment and income, and who own multiple vehicles. These findings provide an initial description of the socio-demographic baseline conditions for electric vehicle users, who remain a relatively limited demographic in certain circles. In the context of this research, it is evident that consumer control of the resources required to purchase an electric vehicle exerts the greatest infuence on the intention and behavior of purchasing an electric vehicle (Tu and Yang, 2019a).

In the context of Indonesia, the discourse on the use of electric vehicles, especially electric motorcycles, should continue to be disseminated on a mass scale, despite the fact that the socio-demographic baseline conditions differ from those of some comparable countries. The

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https://doi.org/10.1016/j.trip.2024.101230
Received 24 February 2024; Received in revised form 13 September 2024; Accepted 14 September 2024
Available online 19 September 2024

imperative to bolster the utilization of electric vehicles is reinforced by an empirical study of the growth model for motorcycles on the island of Java, which predicts that there will be circumstances where the number of motorcycles fueled at a specific time by oil will exceed the population. It is evident that this prediction will have a significant impact on the performance of sustainable transport, particularly on the island of Java (Kresnanto, 2019). In light of more optimistic projections from a sustainability perspective, it is necessary to pursue initiative that will encourage the adoption of electric vehicles. This can be achieved through campaigns, education, persuasion, and policy support for the use of environmentally friendly products, such as electric motorcycles.

In consideration of the historical growth of electric two-wheelers (E2Ws), with an estimated 6 to 7 million motorcycles sold annually and an 82 % ownership rate among Indonesian, it is reasonable to anticipate an increase in E2W adoption, particularly in light of the proposed IDR 7 million incentive (Fig. 1). The incentive could result in approximately 40 % price reductions on the market in 2023 for the average 1.5 kW models, 25 % for the average 2 kW models, and 22 % for the average 3 kW models (Padhilah et al., 2023).

A detailed examination of Indonesia's energy consumption data revealed that in 2019, the total consumption was 1,007.26 BOE (barrel of oil equivalent), with the transportation sector accounting for the highest consumption at 414.98 BOE. This figure represents 41.19 % of Indonesia's total energy consumption (Adi et al., 2020). In particular, the transportation sector has exhibited a gradual increase, with an average growth rate of 7.28 % during the 2009–2019 period (Fig. 2). Further data in Fig. 1 also indicates that fossil fuels represent the predominant energy resource type, accounting for 38.92 % of the total energy consumed by the transportation sector. This highlights the necessity for a systematic approach to monitoring and addressing energy consumption trends in order to achieve sustainable transportation.

Fig. 3 provides further corroboration of the information presented in Fig. 2. The bold dark blue line represents the transportation sector's consumption rate, which illustrates that this sector has consistently accounted for a larger proportion of total energy consumption than the industrial sector since 2012. This observation suggests that Indonesia's transportation policies have not yet achieved the objective of implementing a sustainable transportation scheme.

Moreover, an analysis of Indonesia's energy consumption based on energy resources reveals that fossil fuels continue to represent the dominant energy source. However, during the 2009–2019 period a decline in the trend was observed, with fossil fuel being substituted with biogasoline and electricity. The aforementioned facts elucidate the specifics of electricity usage in the transportation. A preliminary analysis of the data collected prior to the commencement of the present study revealed a significant shortfall in the utilization of electricity as an energy source in the transportation sector, representing a mere 0.032 % of the total energy consumption in this sector. This situation motivates the necessity for the present research, which aims to gain insight into the prospective electricity usage in Indonesia's transportation system.

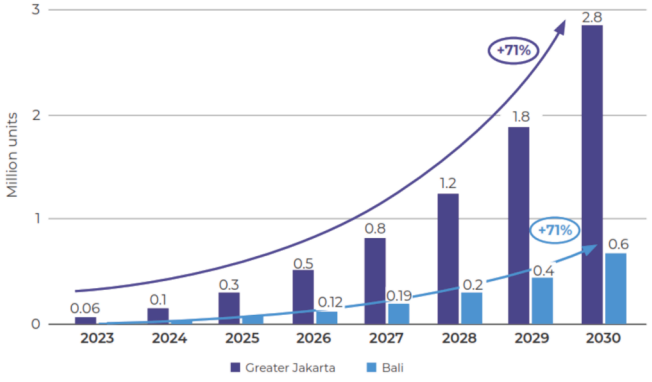

Fig. 1. Projected growth of the electric two-wheeler (E2W) market in Jakarta and Bali with an incentive of IDR 7 million (Padhilah et al., 2023).

A review of energy source data, particularly in the transportation sector (Fig. 4), indicates that electric vehicles remain a relatively uncommon option for fulfilling transportation needs. To enhance the adoption of electric vehicles, the Indonesian government must implement a control command approach and enact robust policies to facilitate the transition from conventional to environmentally sustainable energy sources, particularly in the transportation sector. The urgency of this situation cannot be overstated. One of the policy initiatives that has been proposed is the introduction of subsidies for those who wish to purchase electric vehicles. The objectives of the subsidies is to render the purchase price of electric motorcycles more competitive than that of vehicles powered by oil fuel (X. Zhang et al., 2018b). This fact should be a cause for concern for the government, given that previous studies (Gallagher and Muehlegger, 2011; Roche et al., 2010) have indicated that the premium price of environmentally friendly products represents a considerable barrier to individual behavior, leading to the emergence of phenomena that can be explained by the social dilemma theory. Consequently, policy support in the form of subsidies to address the issue of 'premium prices' is a potential avenue for facilitating the widespread adoption of electric motorcycles as an alternative to conventional motorcycles fuelled by oil. This could help to reduce the individual cost of using environmentally friendly products. Fig. 5 illustrates the predicted growth in the number of electric vehicles and their supporting infrastructure in aggregate in Indonesia.

A slight divergence from the preceeding data is observed in the growth of conventional vehicles in the Special Region of Yogyakarta, which has demonstrated a positive growth trend (Fig. 6). This indicates that transportation-related issues, such as congestion and air pollution, are becoming increasingly prevalent.

The objective of this present research is to ascertain the propensity of conventional motorcycle consumers to transition to electric motorcycles. In this case, a motorcycle was selected as a product to be examined to determine whether it could serve as an icon for changing consumer preferences in choosing environmentally friendly products, given the unusually high number of motorcycle sales. The objective of this present research is to examine the influence of the theory of planned behavior variables, moderated by the incentive variable in the form of a purchase tax subsidy, on the intention to switch to electric motorcycles. It is hypothesized that attitudes, subjective norms, and perceptions of behavioral control, which are moderated by the existence of incentives in the form of purchase tax subsidies, will affect the interest in switching to use an electric motorcycles.

It is anticipated that this research will prompt stakeholders to adopt a more rigorous stance in addressing the alarming proliferation of motorbikes with fuel oil, which represents a significant threat to sustainability performance. Additionally, the findings of this research are expected to enhance the precision of previous empirical studies that have focused on electric motorcycle products and the broader domain of environmentally friendly products.

2. Literature review

2.1. Attitude and intention to use electric vehicles products

In the theory of planned behavior developed by (Ajzen, 1991a), attitude is identified as a key component in shaping individual social behavior. This theory is frequently cited as a reference point for understanding individual behavior related to the use of electric vehicles (Mohamed et al., 2016; Shi et al., 2017; Zhang et al., 2017). Nevertheless, several previous studies have highlighted the necessity for a more comprehensive examination of the internal and external components of attitude formation. These components, in conjunction with other variables, have been demonstrated to influence to the intention to use certain products, suggesting a potential avenue for further research.

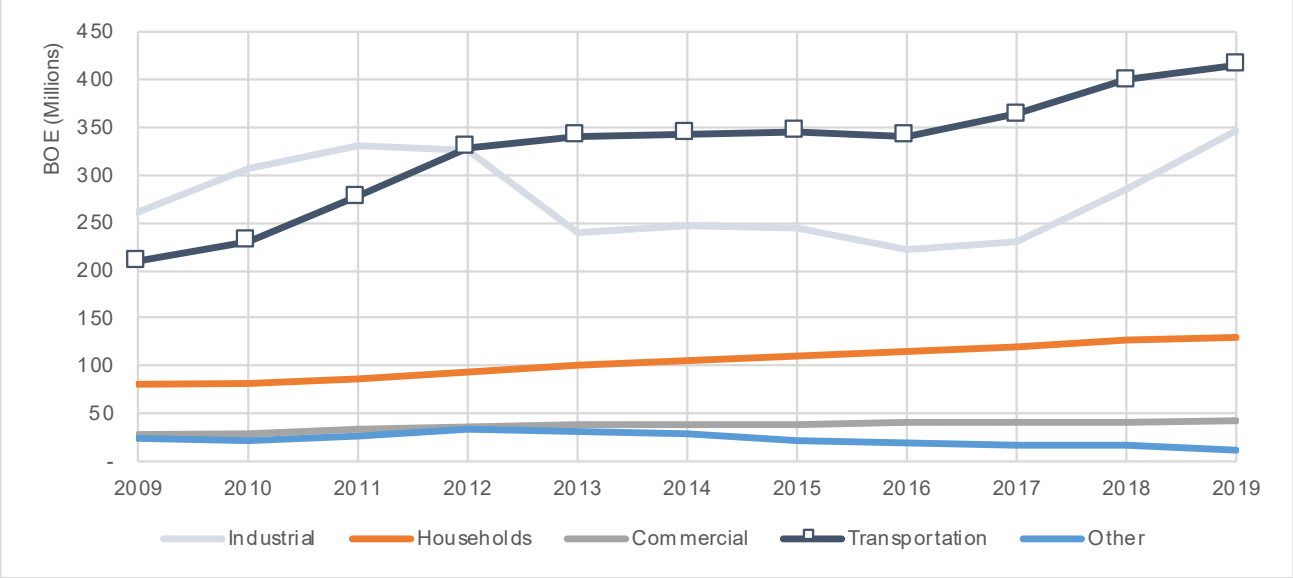

Fig. 2. Trends in energy consumption by sector.

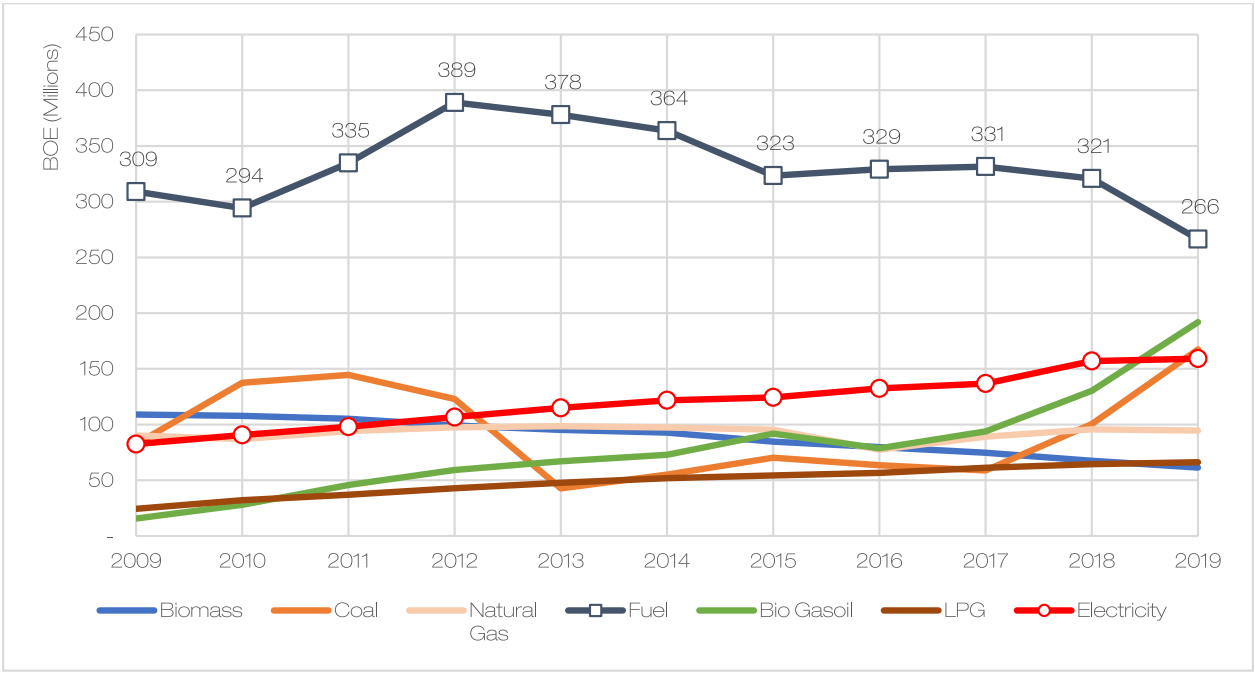

Fig. 3. Trends in energy consumption by type.

As a relatively novel product and in the context of broader market development, the adoption of electric motorcycles is still significantly influenced by a range of preliminary information that can stimulate potential consumers' curiosity. The impact of advertising, promotion, and marketing doctrine on sustainability and environmentally friendly issues represents a significant motivating factor influencing individual attitudes toward perceptions of its use (X. Zhang et al., 2018b). Additionally, attitudes are shaped by a range of other factors, including individual identity, self-efficacy, moral norms, and subjective norms, which collectively contribute to the intention to purchase an electric motorcycle (Mohamed et al., 2016; Shi et al., 2017). Based on the aforementioned research, the following hypothesis was proposed in consideration of Indonesia's socio-demographic context, particularly within the Special Region of Yogyakarta:

H1: Individual attitudes have a positive influence on the intention to use electric vehicle products.

2.2. *Subjective norms and intention to use electric vehicle products*

Subjective norms, defined as individual perceptions shaped by the influence of people or community perceptions, serve to guide individuals in their decision-making regarding the performance or non-performance of certain behaviors (Ajzen, 1991a). The influence of perceptions and knowledge regarding environmentally friendly behaviors contributes to the formation of individual subjective norms (Armitage and Conner, 2010b; Haustein and Jensen, 2018). This understanding underscores the importance of bridging the gap between intention and behavior, as it can still occur due to unsupportive individual socio-

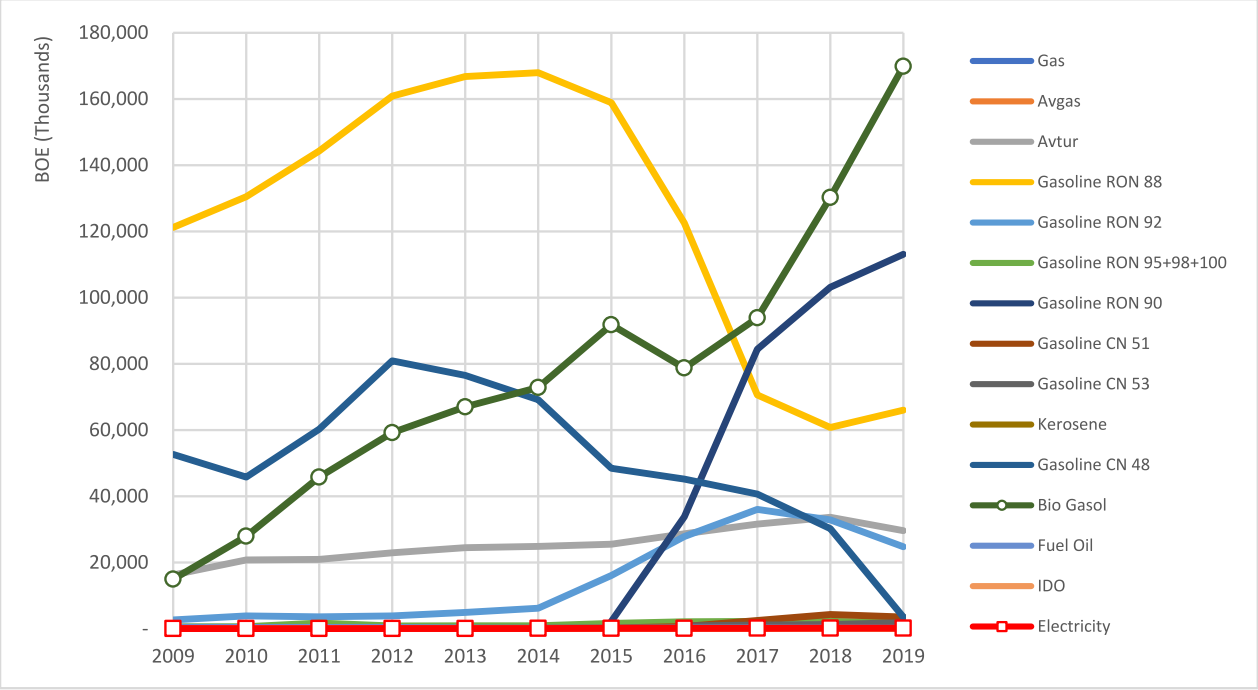

Fig. 4. Trends in fuel consumption by type in the transportation sector.

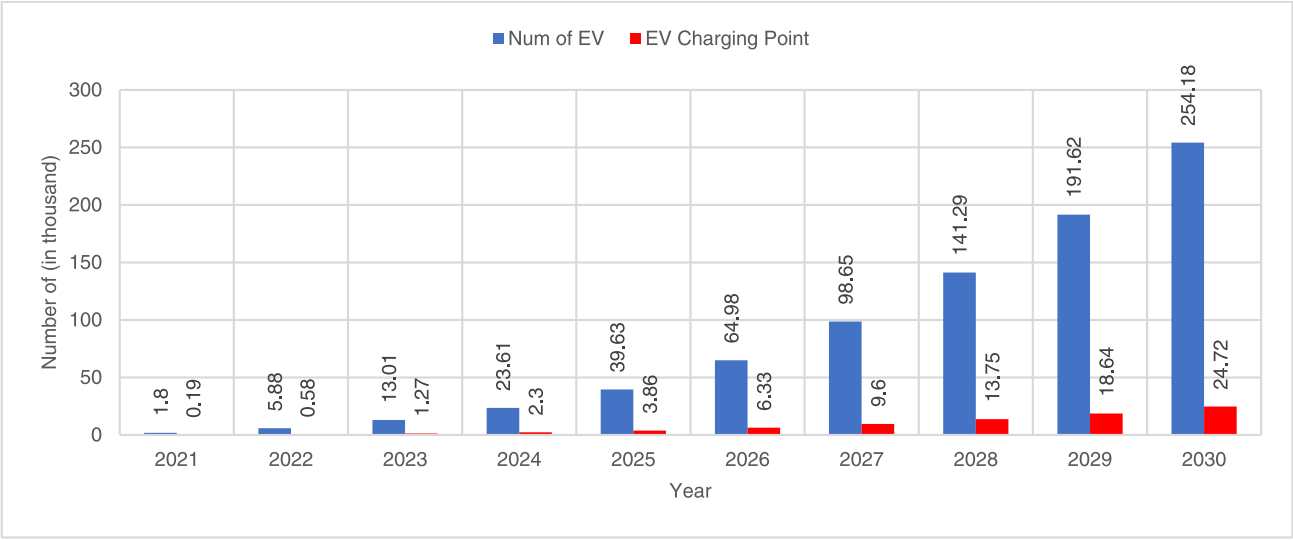

Fig. 5. Projected number of electric vehicles and electric charging stations in Indonesia until 2030 (in thousand units).

demographic factors (Barbarossa and De Pelsmacker, 2016; Vringer et al., 2017).

The influence of subjective norms on the intention to use electric vehicle products has been extensively studied by Mohamed et al. (2016) and Shi et al. (2017). In these empirical studies, subjective norms were found to have a positive effect on the use of electric vehicles. Based on the above explanation, the present research aimed to investigate the relationship between the two variables in the Indonesian context, which differs from that in the aforementioned previous research in terms of the socio-demographic background. Consequently, a hypothesis was proposed as follows:

H2: Subjective norms have a positive influence on the intention to use electric vehicle products.

2.3. Perceived behavioral control and intention to use electric vehicle products

Perceived behavioral control refers to an individual's perceptions of the ease or difficulty associated with a particular action or behavior (Ajzen, 1991a). It is frequently associated with beliefs about specific opportunities or resources and perceptions of the degree of importance of particular opportunities or resources. In summary, it can be stated that the absence of the necessary ability to take action will directly impede an individual's decision to behave in accordance with their perception, irrespective of the level of attitudes they possess and the subjective norms they adhere to (Ajzen and Madden, 1986). Perceived behavioral control exerts a direct influence on behavior and an indirect influence on behavior through behavioral intention (Chen et al., 2016).

In the context of research on the intention to use environmentally

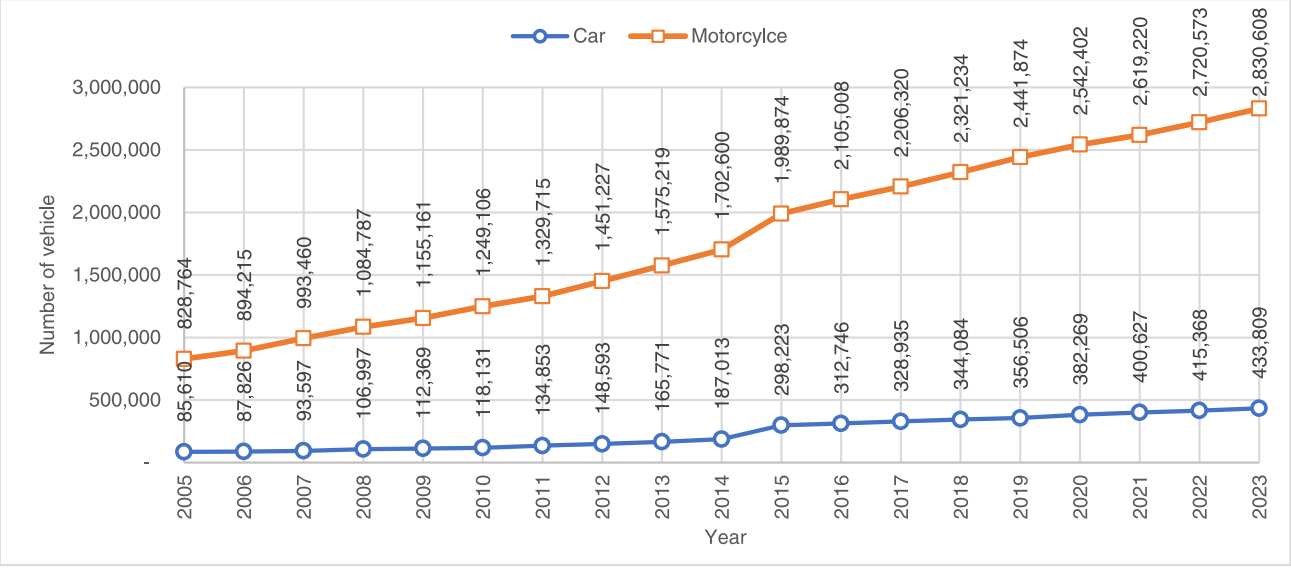

Fig. 6. Growth of conventional vehicle in the Special Region of Yogyakarta.

friendly products, several previous studies have demonstrated that perceived behavioral control has a positive effect on the intention to use environmentally friendly products (Mohamed et al., 2016; Shi et al., 2017; Wang and Dong, 2016). Given the existence of diverse socio-demographic background conditions, the present research sought to examine whether similar findings could be observed in the Indonesian context. Based on this rationale, the third hypothesis was proposed as follows:

H3: Perceived individual behavioral control has a positive influence on the intention to use electric vehicle products.

2.4. Incentives in the form of purchase tax subsidies

The association of environmentally friendly products with a "premium" image results in a lower absorption rate for such products in the market due to their less competitive prices (Gallagher and Muehlegger, 2011; Putri and Setianan, 2020b; Roche et al., 2010; Zhang et al., 2017). This phenomenon is exemplified by electric vehicle products, which have a relatively high price differential compared vehicles powered by fossil fuels.

In order to encourage the wider use of environmentally friendly products, particularly electric vehicles, it would be beneficial for the government to implement a number of initiatives. These could include, for example, price subsidies, vehicle tax cuts and a variety of other non-financial incentives (Sierzchula et al., 2014). However, given that the use of electric vehicles is still a "novel initiative" in the Indonesian context, this research specifically considered the potential for government policy intervention in the form of purchase tax subsidies to bolster purchases and expand market share.

Prior research has demonstrated that financial incentives can facilitate the growth of electric vehicle market share (Sierzchula et al., 2014; Zhang et al., 2017). A number of countries have implemented tax incentives for the purchase of electric vehicles, including the United States and China. Nevertheless, the global market share of electric vehicles remained below 1 % of total vehicle sales until 2016. The relatively low share of the sales market for electric vehicles globally indicates that the expansion of electric vehicles could not have occurred on a significant scale without the support of government policies. Based on the aforementioned explanation, the present research considered this tax incentive variable to be included as a moderator in the research model to determine the magnitude of its influence on the intention to use electric vehicle products.

2.5. Attitudes, subjective norms, perceived behavioral control, incentives, and intentions to use electric vehicle products

The discrepancy between intention and behavior with regard to the use of environmentally friendly products has been the subject of previous studies (Barbarossa and De Pelsmacker, 2016; Longo et al., 2019). The findings of these studies indicate that government intervention is necessary to enhance the use of environmentally friendly products, particularly electric motorcycles, in order to prevent the occurrence of the phenomenon postulated by the social dilemma theory. This phenomenon is characterized by the successful influence of perceptions of attitudes, subjective norms, and perceived behavioral control on the intention to use, which cannot be translated into actual behavior because of the presence of barrier factors related to different socio-demographic backgrounds of individuals. The efficacy of financial incentives as intervention strategy has been empirically studied in various countries, with findings indicating that such incentives can effectively reduce the discrepancy between intention and behavior (Sierzchula et al., 2014; Zhang et al., 2017), foster perceptions of economic benefits, and influence the intention to make a purchase.

Despite the established relationship between consumer perceptions of incentive policies and the environmental benefits and risks associated with the use of electric vehicles (X. Zhang et al., 2018b), this research aimed to ascertain the extent to which tax incentives act as a moderating variable on the three antecedent variables in the theory of planned behavior, with particular focus on their influence on the intention to use electric vehicle products. This research is necessary because previous studies have demonstrated that the levels of each antecedent variable in the theory of planned behavior vary with regard to the use of environmentally friendly products (Shi et al., 2017). In light of these considerations, this empirical research is necessary to ascertain whether incentives in the form of purchase tax subsidies can act as a moderating variable for the association between attitudes, subjective norms, and perceived behavioral control and the intention to use electric vehicles. This investigation is essential to ascertain whether there is a difference in effect when the three variables in the theory of planned behavior are directly linked to the intention to use, compared to when they are moderated by an incentive variable in the form of a purchase tax subsidy. Consequently, the following hypothesis was proposed:

H4: Attitudes, subjective norms, and perceptions of individual behavior control, when moderated by incentives in the form of purchase tax subsidies, exert a positive effect on the intention to

switch to the use of electric vehicle products.

In summary, the hypothesis development can be incorporated into the proposed model in this research, as illustrated in Fig. 7.

3. Methodology

This research methodology involved the development of multi-item measures for each construct through the following process. The constructs and their corresponding measurement items were developed by adapting the relevant and existing literature to align with the specific theme and context of this research. Subsequently, the literature review facilitated the selection of sixteen items for five constructs. A seven-point Likert scale was employed for all measurement item, with anchors ranging from strongly disagree (1) to strongly agree (7). This research analyzed the following three dimensions of the theory of planned behavior: attitude (5 items), subjective norm (3 items), and perceived behavioral control (3 items), respectively. These items were modified from Zhang et al. (2018) (K. Zhang et al., 2018a) and two items for tax incentives were adapted from Putri and Setianan (Putri and Setianan, 2020a).

3.1. Sample Justification

It is believed that the adoption of electric vehicles represents a potential means of reducing the global impact of greenhouse gasses. Indonesia has also demonstrated a commitment to addressing this issue, recognizing the urgent need to reduce the rapid increase in carbon emission resulting from the massive use of fossil fuel vehicles. Prior research conducted by the present research's primary investigator indicates that the growth rate of fossil fuel vehicle usability in Indonesia during the 2014–2016 period was approximately 14.55 % per year (Kresnanto, 2019).

It is crucial to acknowledge that the implementation of carbon emission reduction strategies in Indonesia cannot be solely based on the policies adopted by developed countries as a benchmark. For instance, the transition to electric passenger transportation without considering the impact of price policies may not feasible in Indonesia, given the country's price sensitivity toward electrification.

Behavioral perceptions serve as key determinants of individual decision-making process, particularly in the context of electric vehicle usage. In this research, price considerations were indentified as a factor that influences decision-making in individual behavioral intentions. Therefore, the policy support for providing tax incentives to subsidize electric vehicles' purchase is considered a significant factor in increasing interest in the behavior of using electric vehicles.

The selection of the research location in Yogyakarta, a province-level special region of Indonesia, was based on the region's ratio of 0.74 point vehicles per capita, which is classified as one of the highest in Indonesia in comparison to other provinces. Fig. 8 illustrates the ratio of the number of vehicles to the population in all provinces in Indonesia.

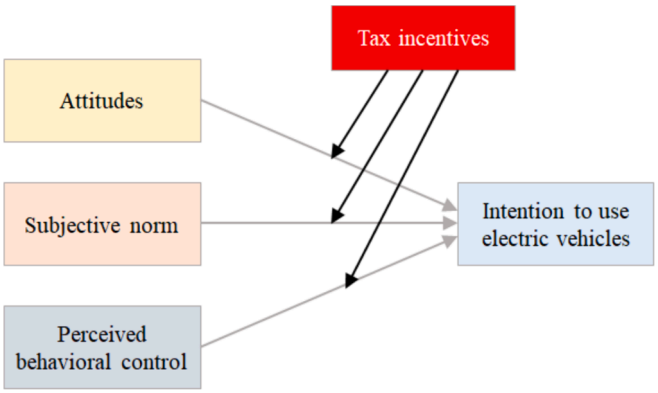

Fig. 7. The proposed model.

3.2. Data collection

A survey was conducted on individuals with experience using fossil-based fuel vehicles. They were instructed to answer all questionnaire items based on their intention to use electric vehicles. This approach was taken to enhance the external validity of the research. A cluster random sampling method was employed, along with an online survey that was conducted over a five-week period.

In this research, the geographic segmentation was employed to ascertain the representation of the sample in each district of the Special Region of Yogyakarta. A total of 420 questionnaires were distributed, 412 were returned. Following the removal of redundant and incomplete questionnaires, the effective sample size was 400. Table 2 presents a summary of the demographic characterictics of the respondent.

3.3. Spatial data

In this research, greater emphasis was placed in the residential location data and age of respondents, given the supposition that individuals residing in urban area are more receptive to novel trends, particularly with regard to the intention to use electric vehicles. A review of the spatial data revealed that the majority of respondents resided in urban areas. Additionally, the age distribution indicated a higher proportion of younger respondents, which supports the proposition that younger individuals are more receptive to new technologies and not resistant to change. This fact reinforces the findings of the present research.

Fig. 9 illustrates the respondents' occupational and educational backgrounds. The majority of respondents were employed in occupations not included in the specified criteria. Additionally, the majority of respondents had obtained a Bachelor's degree, indicating that many respondents were drawn from the educated community.

3.4. Proposed model and variable selection

The latent exogenous variables in this research were comprised of three constructs: subjective norm (ξ_1), attitude (ξ_2), and perceived behavioral control (ξ_3). Moreover, two endogenous latent constructs, tax incentive (η_1) and intention to use EVs (η_2), were included to introduce novelty. As illustrated in Fig. 10, the factor loading of the latent exogenous variable comprises 10 indicators ($\lambda_{x1\text{-}10}$), while the factor loading of the latent endogenous consists of 5 indicators ($\lambda_{y1\text{-}5}$). Additionally, each measurement error in the exogenous variable ($\delta_{1\text{-}10}$) and measurement error in the endogenous variable ($\varepsilon_{1\text{-}5}$) is presented. In the context of the overall model, the measurement error is represented by $\varsigma_{1\text{-}2}$, while $\beta 1$ denotes the coefficient of the levelof influence exerted by an endogenous variable on another endogenous variable. The indicators for each latent variable are explained as in the Table 1.

3.5. Data processing

The collected data were subjected to multivariate analysis, specifically partial least squares (PLS) modelling. The objective of PLS modelling is to identify the multidimensional direction in the independent variable space that explains the maximum multidimensional variance direction in the response variable space. The modelling is suitable for conducting PLS-SEM with nonnormal data, as it transforms the nonnormal data in accordance with the central limit theorem (Hair et al., 2014a). This descriptive statistical analysis enables the research questions to be answered and conclusions to be drawn from this research.

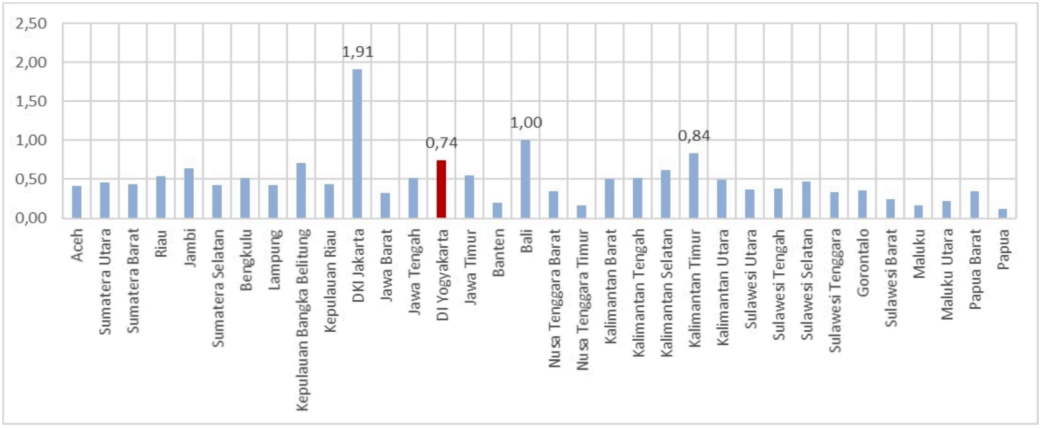

Fig. 8. Ratio between the number of vehicles to the population in each province in Indonesia.

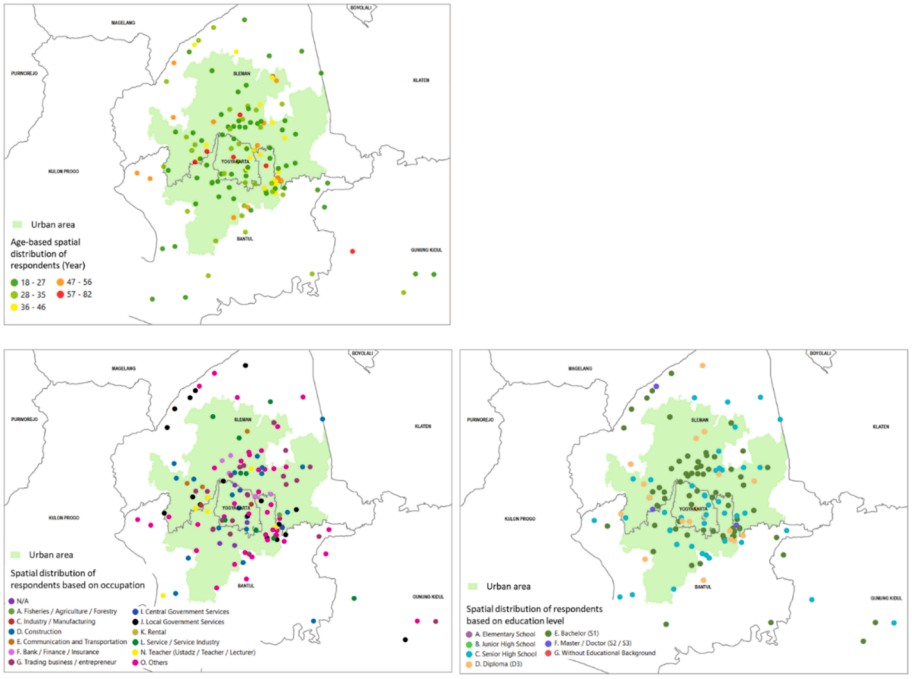

Fig. 9. Spatial distribution of respondents based on age, occupation, and education level.

3.6. Analysis of the outer model

To assess the outer model of the factors and to test the inner model and relevant research hypotheses, a two-stage approach was employed. SmartPLS 2.0 software was selected as the PLS analytical tool. SmartPLS is one of the component-based structural equation model (SEM) analytical techniques (Rigdon et al., 2010).

In accordance with the recommendations of Hair (Hair et al., 2014b), the factor loadings should exceed 0.5 higher. All standardized factor loadings of pointer variables within each construct were above 0.5, thus satisfying the standard for further analysis (shown in Table 3).

Internal consistency was evaluated through the use of composite reliability. Composite reliability values exceeding 0.7 are indicative of satisfactory internal consistency, as per the established fidelity requirement. As illustrated in Table 3, all composite reliability values surpassed the threshold, thereby substantiating the aforementioned conslusion.

Convergent validity refers to the strength of the correlation between variables observed directly and varibles within the same construct. As the correlation degree increases, so too does the level of convergent validity. Fornell & Larcker (Fornell and Larcker, 1981) established three criteria for evaluating the strength of convergent validity: (1) factor loadings for each construct should exceed 0.7; (2) composite reliability should be greater than 0.6; and (3) average variance extracted (AVE) should be above 0.5.

Table 3 demonstrated that all of the criteria established by Fornell & Larcker were met. Specifically, the measurement items exhibited factor loadings exceeding 0.7, composite reliability values exceeding 0.6, and AVE values exceeding 0.5. Consequently, it can be concluded that all constructs demonstrated satisfactory convergent validity.

3.7. Analysis of the inner model

The overall quality of the research model was evaluated using the Goodness of Fit (GoF) statistic, which yielded a value of 0.622, exceeding the established cut-off of 0.36 for a large effect size. This result indicates that the proposed model exhibited a good overall fit, allowing for the conclusion that the model in the present research

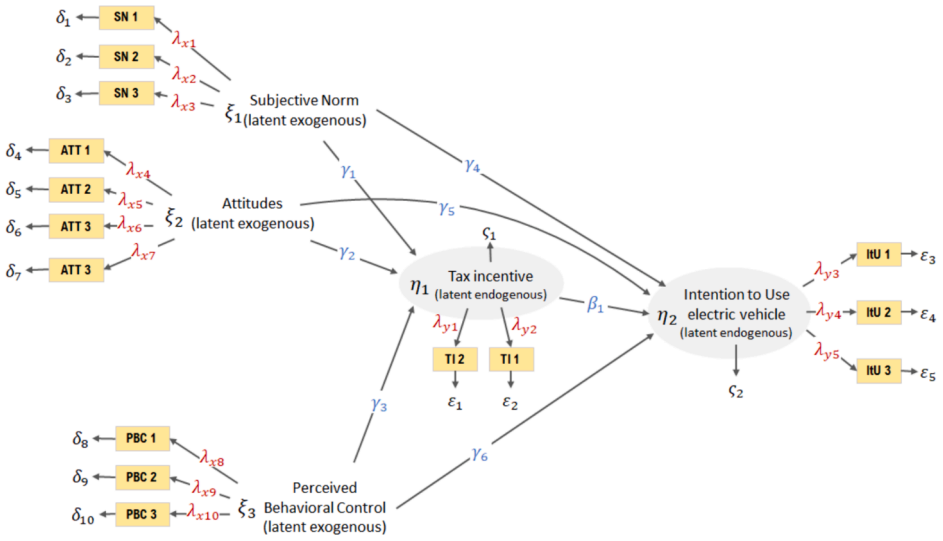

Fig. 10. Model formulation.

Table 1
Latent variable indicators.

Latent Variables	Code	Indicators	Code
Subjective Norm (latent exogenous)	ξ_1	Some important people in my life think I should consider purchasing an electric vehicle.	SN 1
		I feel societal expectations for buying an electric vehicle (EV)	SN 2
		People who are near to me consider environmental factors essential when purchasing a vehicle	SN3
Attitude (latent exogenous)	ξ_2	Purchasing an electric vehicle is, in my opinion, more economical in the long run than owning a conventional vehicle	ATT 1
		Purchasing electric cars (EVs) will help combat climate change.	ATT 2
		I think buying an EV is a smart choice.	ATT 3
		To switch from conventional to electric automobiles, I'm willing to set aside a portion of my income.	ATT 4
Perceived Behavioural Control (latent exogenous)	ξ_3	I'm sure that operating and maintaining an EV is simple.	PBC 1
		I wouldn't hesitate to purchase an EV if it came with an outstanding warranty.	PBC 2
		Despite their limitations, I believe EVs can still fulfil my needs for travel.	PBC 3
Tax Incentive (η1) (latent exogenous)	η1	Offering tax incentives will persuade me to think about buying an electric vehicle	TI 1
		I believe that tax incentives will encourage more individuals to purchase electric vehicles	TI 2
Intention to Use EV's (latent endogenous)	η2	I'd be willing to purchase an EV soon.	ITU 1
		Purchasing an EV is my initial goal	ITU 2
		I am getting ready to buy an EV.	ITU 3

Table 2
Demographic attributes of the respondent.

Characteristic	N=400	%
Gender		
Male	223	55.75
Female	177	44
Age		
Under 21	28	7.00
21 – 30	189	47.25
31 – 40	77	19.25
41 – 50	58	14.50
51 – 60	38	9.50
61 – 70	9	2.25
70 above	1	0.25
Occupation by Sector		
Fisheries/agriculture/forestry	6	1.50
Industry/manufacturing	9	2.25
Construction	45	11.25
Communication and transportation	7	1.75
Banking/finance/insurance	15	3.75
Trading business/entrepreneurship	85	21.25
Central government services	6	1.50
Local government services	33	8.25
Rental and leasing	4	1.00
Service industry	16	4.00
Education (*ustad*/school teacher/lecturer)	25	6.25
Others	131	32.75
N/A	18	4.50
Educational Attainment		
Elementary school diploma or equivalent	3	0.75
Junior high school diploma or equivalent	5	1.25
Senior high school diploma or equivalent	127	31.75
Associate degree	47	11.75
Bachelor's degree (S1)	196	49.00
Master's degree/doctoral degree	21	5.25
Absence of an educational background	1	0.25
Electric Vehicle (EV) Ownership		
EV automobile	28	7
EV motorcycle	4	1

demonstrated a superior performance compared to the baseline values established in Fig. 11.

Bootstrapping resampling was employed to ascertain the significance of the path coefficients within the inner model, with1,000 iterations conducted. Table 4 presents the path coefficients of the inner model. In order to ascertain whether the hypothesis put forth in the present research is accepted or rejected, a number of rule of thumb criteria were employed (Hair et al., 2014b). The first criterion was to examine the t-statistic value. If the t-statistic value is greater than the t-table value, then the hypothesis is accepted, indicating a significant relationship between the two variables. If the t-value of the path coefficient is greater than 1.96, the confidence level is higher than 95 %, suggesting a strong influence of the path coefficient.

The second criterion was to examine theP-values, whereby the hypothesis is accepted if the P-values are less than 0.05. The results of the test yielded interpretations of the P-values that were consistent with the t-statistic. Additionally, the direction of the relationship between the hypothesized variables can be discerned from the original sample value or the parameter coefficient. If the parameter coefficient exhibits a

Table 3
Factor loadings, reliability, and convergent validity.

	ModEf SN	ModEf PBC	ModEf ATT	TI	ItU	SN	PBC	ATT	Composite Reliability	AVE
TI 1	−0.174	−0.268	−0.088	0.998	0.583	0.578	0.726	0.572	0.998	0.996
TI 2	−0.184	−0.279	−0.096	0.998	0.578	0.574	0.719	0.566		
ITU 1	−0.135	−0.192	−0.133	0.523	0.853	0.554	0.68	0.593	0.912	0.776
ITU 2	0.006	0.029	−0.128	0.554	0.890	0.679	0.676	0.749		
ITU 3	−0.087	−0.083	−0.188	0.453	0.900	0.546	0.591	0.617		
SN*TI	1	0.743	0.618	−0.179	−0.077	−0.025	−0.103	−0.024	1	1
SN 1	0.085	−0.018	−0.028	0.531	0.625	0.807	0.649	0.654	0.926	0.807
SN 2	−0.078	−0.12	−0.012	0.491	0.583	0.935	0.62	0.641		
SN 3	−0.08	−0.13	−0.019	0.526	0.612	0.947	0.653	0.671		
PBC*TI	0.743	1	0.604	−0.274	−0.087	−0.098	−0.183	−0.068	1	1
PBC 1	−0.068	−0.13	−0.063	0.464	0.662	0.632	0.935	0.639	0.908	0.769
PBC 2	−0.163	−0.255	−0.076	0.986	0.593	0.583	0.732	0.582		
PBC 3	−0.05	−0.108	−0.038	0.497	0.683	0.664	0.948	0.693		
ATT 1	0.005	−0.022	−0.151	0.468	0.642	0.635	0.586	0.930	0.902	0.701
ATT 2	−0.016	−0.06	−0.164	0.442	0.601	0.603	0.544	0.912		
ATT 3	0.014	−0.04	−0.106	0.451	0.702	0.712	0.77	0.801		
ATT 4	−0.1	−0.118	−0.228	0.56	0.526	0.464	0.505	0.683		
ATT*TI	0.618	0.604	1	−0.092	−0.168	−0.022	−0.066	−0.189	1	1

Notes: AVE (average variance extracted)

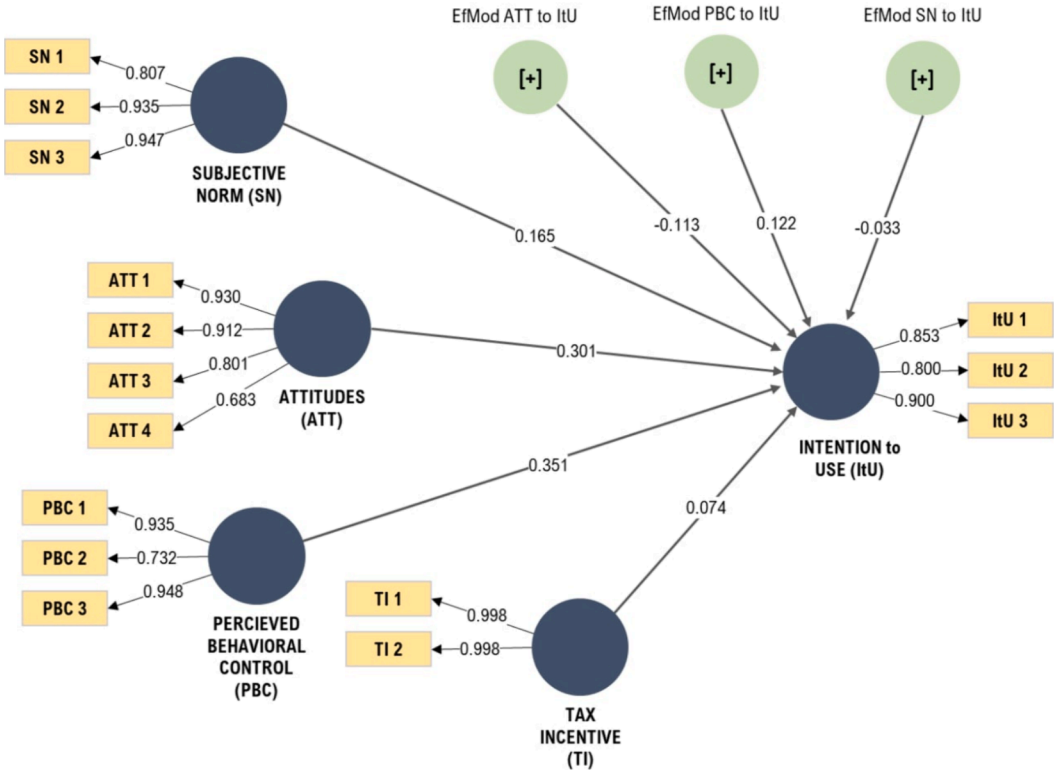

Fig. 11. Partial least squares structural equation modeling.

positive value, the relationship between the two variables is identified as positive. Conversely, if the parameter coefficient value demonstrates a negative value, the relationship between the variables is determined to be negative.

4. Results

A 65.6 % explanatory power was achieved for the model used to explain intention to use electric vehicles based on the analysis of the data information. The findings of the survey supported the initial hypothesis (H1), whcih stated that individual attitudes have a positive influence on the intention to use electric vehicle products**.** An attitude is an individually introverted experience or evaluation of whether one's behavior toward a target behavior is advantageous or disadvantageous (Chen and Hung, 2016). The present research also supported the second hypothesis (H2), namely that subjective norms exert a positive influence on the intention to use electric vehicle products**.** It may be observed that expectations and pressure to use environmentally friendly products from significant others (e.g., parents, teachers, spouses and professionals) significantly affect the intention to use electric vehicle products.

In addition, the third hypothesis (H3), which posited that perceived individual behavior control exerts a positive influence on the intention to use electric vehicle products, was also corroborated by the present research. Perceived behavioral control refers to the perceived likelihood and resources required to perform a given behavior. In other words, it is the extent to which individuals believed they can engage in a specific

Table 4
Summary of the results of the inner model.

Hypothesis	Path Coefficient	TStatistics	P-Values	Result
ModEf SN −> ItU	−0.033	0.780	0.436	Not Supported
ModEf PBC −> ItU	0.122	2.629	0.009	Supported
ModEf ATT −> ItU	−0.113	2.444	0.015	Not Supported
TI −> ItU	0.074	1.641	0.101	Not Supported
SN −> ItU	0.169	3.229	0.001	Supported
PBC −> ItU	0.359	5.970	0.000	Supported
ATT −> ItU	0.301	4.537	0.000	Supported

behavior. One of the core tenets of perceived behavioral control is the availability of resources and the number of opportunities to perform a given behavior. The findings of the present research align with the proposed models of the theory of planned behavior, indicating that the antecedent variables supported the dependent variable.

The fourth hypothesis (H4) posited that tax incentives would act as a moderating variable for the three antecedent variables. The results indicated that the moderating effect of tax incentives on the subjective norm was not supported with regard to the intention to use. Notably, tax incentives themselves also lacked the capacity to influence the intention to use an electric vehicle. This finding suggests that tax incentives may not be a standalone variable capable of influencing the intention to use an electric vehicle. The two variables that could be moderated with tax incentives were attitude and perceived behavioral control.

As illustrated in Table 5, the impact of tax incentives on the uptake of electric vehicles was not uniform accross countries and cities. In particular, the evidence from Indonesia suggests that such incentives may not be a significant driver of this transition. This finding aligns with the conslusion of a study conducted in China in 2021.

This present research indicates that further investigation is required to ascertain the status of incentivized environmentally-conscious behavior, particularly with regard to the use of electric motorcycles.

5. Discussion

Given the interdisciplinary nature of the field, a substantial body of research has been conducted to elucidate the factors influencing the adoption of electric vehicles (Evs) (Greenblatt and Saxena, 2015). This research encompasses a range of perspectives, including technological (Park et al., 2018; Tu and Yang, 2019b; Wang et al., 2018; Wu et al., 2020), socioeconomic (Wu et al., 2020), and environmental benefits (Degirmenci and Breitner, 2017; He et al., 2018; Morganti and Browne, 2018; Wu et al., 2019). It also considers the functional and non-functional value of EVs (Han et al., 2017) and the perceived risks associated with them (Jing et al., 2019; Wang et al., 2018).

A substanial body of prior research has identified the technology acceptance model-theory planned behavior as a fundamental theory, with its extensive use by numerous researchers (Haustein and Jensen, 2018; Jing et al., 2019; Park et al., 2018; Tu and Yang, 2019b; Wang et al., 2018; Wang and Dong, 2016; Wu et al., 2019). This underscores its importance and influence. Building on this, and considering the numerous empirical studies and suggestions for further research that highlight cost as a primary barrier to electric vehicle adoption, the present research has introduced tax incentives as crucial moderating variables, which could significantly influence the research outcomes.

The lack of interest in EVs among Indonesians can be attributed to a number of factors, including the high initial purchase price, inadequate charging infrastructure, and the absence of government incentives (Candra, 2022). It is imperative to recognize that the concurrent implementation of EV-supporting infrastructure and incentives is merely advantageous, but indispensable for accelerating the adoption of EVs. It is evident that a single policy cannot effectively encourage the use of Evs. Past experience has demonstrated that government incentives have not been a sufficient trigger for switching conventional vehicles to electric vehicles (Yuniza et al., 2021). It is therefore clear that more than a single policy is needed to drive EV adoption. The implementation of EV-supporting infrastructure must be simultaneous with incentives. A combination of price incentive policies and increased access to charging stations is the most effective policy to boost EV sales (Mersky et al., 2016; Shah, 2022; Waseem et al., 2023; Yu et al., 2023).

At the time of writing, the Special Region of Yogyakarta is equipped with a mere nine charging stations, as illustrated in Fig. 12. Such an uneven distribution of charging stations may potentially influence individuals' decisions regarding the purchase of EVs. The spatial disparity of charging stations in the region is indicative of the significance of this issue in the electric vehicle industry. As Yu et al. (2023) have noted, the deployment of EV-supporting infrastructure, particularly charging stations, must be planned on a spatial basis in accordance with the EV population, energy sources availability, and station proximity. This balanced distribution is crucial to meet the demand and encourage EV adoption (Frade et al., 2011).

Furthermore, the preceeding research is closely related to behavioral theory and technology acceptance theory. Consequently, some of the findings of the present research are consistent with those of previous research, thereby reinforcing the notion that intention to use is significantly influenced by attitude, perceived behavioral control, and subjective norm. It is regrettable that technological acceptance theory is employed solely to assess acceptance, with less emphasis on its potential power to influence societal perspectives related to environmentally conscious behavior. It is hoped that the potential power of technology acceptance theory, particularly in supporting environmentally responsible behavior, will be advanced and integrated with the principles of social dilemma theory to enhance sustainable transport performance.

Table 5
Summary of the results of the inner model.

Research	Case Study Location/ Data Type	Type of Tax Incentive	Impact on EV Sales/Ownership			
			Significant	Moderate/ Inconsistent	Insignificant	Unknown
(Hasudungan et al., 2024)	Special Capital Region of Jakarta, Indonesia	Tax credits for electric vehicles	V			
(Wibowo and Septiari, 2023)	Scraping Twitter data			V		
(Liu et al., 2021)	China	Exemption from taxation on the purchase of an			V	
(Liu, 2023)	China	electric vehicle	V			
(Clinton and Steinberg, 2019)	The US	Tax credits for electric vehicles	V			
(Yuniza et al., 2021)	Indonesia	Incentive program for electric vehicle batteries			V	
(Mersky et al., 2016)	Norway	Incentives for the adoption of EV and EV charging		V		
(Shah, 2022)	India	Tax credits for electric vehicles				V

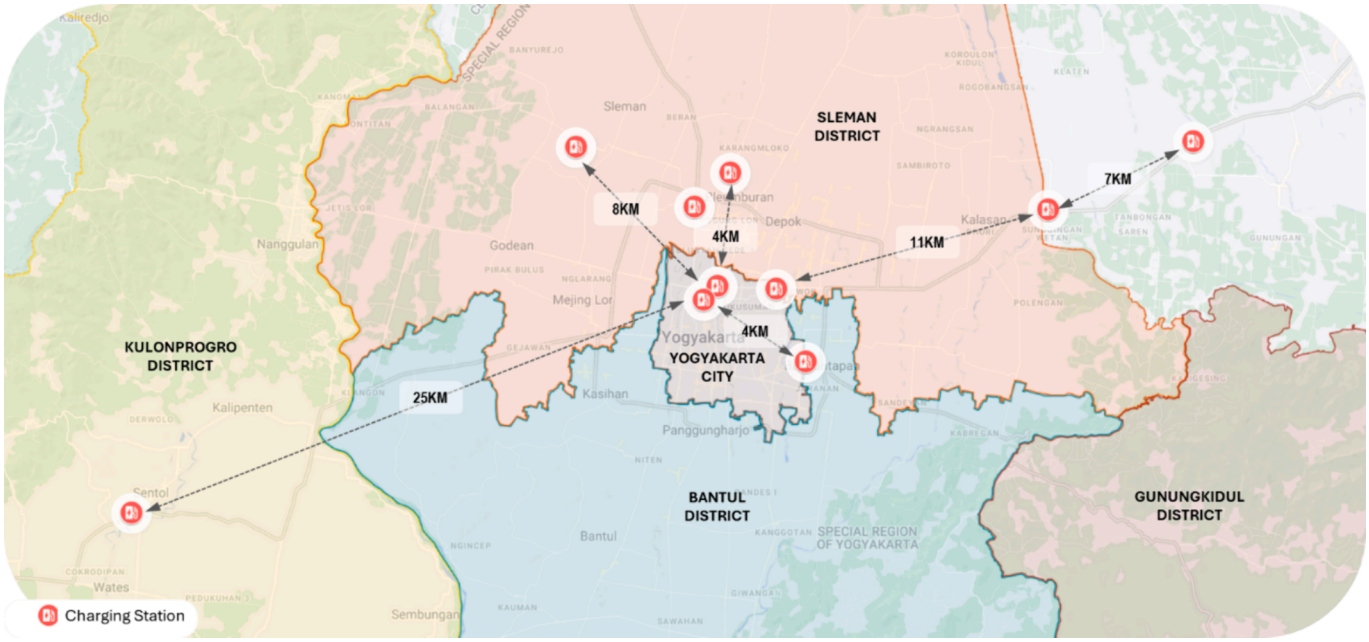

Fig. 12. Spatial distribution of electric vehicle charging stations in the Special Region of Yogyakarta.

The present research posits that tax incentives may serve as a key factor in prmoting the adoption of electric motorcycles and, consequently, influencing the broader adoption of electricity as an energy source. However, the findings of this research indicated that the EV tax incentive policy must be reinforced in order to increase the public's desire to utilize EVs. It is evident that additional accompanying policies are required, particularly those aimed at enhancing the infrastructure for EVs, such as the establishment of a network of evenly distributed charging stations in development areas. The logical conclusion that can be drawn from these findings is that with the implementation of appropriate policies, the costs associated with he adoption od electric vehicles can be significantly reduced, thereby making them more accessible to the general public. It is anticipated that this will lead to a reduction in air pollution and carbon emissions, particularly in Indonesia.

6. Conclusions

The present research aims to ascertain the probability of switching behavior from conventional or fossil fuel-powered motorcycles to electric motorcycles by involving tax incentives as a potential catalyst. The findings indicate that tax incentives, when utilized as a policy to reduce the financial barriers associated with the adoption of electric motorcycles, may not be a standalone factor influencing individuals to make environmentally conscious decisions. In line with theory of planned behavior (TPB), this research demonstrates that the three key variables, namely subjective norm, attitude, and perceived behavioral control, collectively shape the intention to adopt environmentally friendly behaviors.

In light of these findings, it becomes evident that the provision of incentives as a means of reducing cost is an insufficient solution to the primary challenge underlying switching behavior. The establishment of preconditions pertaining to subjective norms, attitudes, and perceived behavioral control within the community represents a crucial aspect in the transformation of environmentally conscious behavior. This observation is corroborated by the research findings, which indicate that only perceived behavioral control, when moderated by tax incentives, has the potential to enhance the intention to utilize electric motorcycles. Tax incentives, however, cannot be regarded as a moderating variable for attitude and subjective norms to elevate the intention to use.

It is thus imperative to disseminate information containing testimonials about the experience of using electric motorbikes to the public, with the aim of bolstering perceived behavioral control and supporting the intention to use an electric motorcycle. Such measures should be accompanied by the implementation of tax incentives that reinforce the adoption of its use. Furthermore, the research findings indicate that there is a need to pay closer attention to the role of spatial data in calculating the target group in the context of forming perceived behavioral control about an electric motorcycle, particularly in relation to factors such as educational background, residential area, and occupation.

CRediT authorship contribution statement

Nindyo Cahyo Kresnanto: Visualization, Methodology, Formal analysis, Data curation, Conceptualization. **Wika Harisa Putri:** Methodology, Formal analysis, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

No data was used for the research described in the article.

Acknowledgment

This research was conducted and funded by the Faculty of Economics and Business of Janabadra University, Indonesia, as part of a research grant competition scheme.

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