Analysis of the influence of greenwashing and well-to-wheel emissions on consumer preferences for BYD electric vehicles

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Abstract

The green economy programme reflects Indonesia's commitment to renewable energy development and sustainable development in order to realise the Indonesia Emas 2045 vision. The purpose of this study is to analyse the influence of greenwashing and well-to-wheel (WTW) emissions on consumer preferences for BYD electric vehicles. This study uses quantitative descriptive analysis with purposive sampling, involving 120 respondents who are prospective users of BYD electric vehicles. Primary data was collected through a questionnaire distributed via Google Forms, and secondary data was obtained from a review of previous research literature. Data analysis was performed using SPSS version 25. The results of this study indicate that greenwashing has a significant negative effect on consumer preferences for electric vehicles, while well-to-wheel emissions have a significant positive effect on consumer preferences for BYD electric vehicles.

Keywords: *Greenwashing, well-to-wheel emissions, consumer preferences, BYD electric vehicles*

Introduction

The policy on battery-based electric motor vehicles has been made a national commitment to accelerate the transition to renewable energy and reduce dependence on fossil fuels in the transportation sector (Indonesian Presidential Regulation No. 79 of 2023). According ESDM (2023) explains that coal-fired power plants still dominate the national electricity system, contributing around 66% of the total installed capacity. This situation indicates that the dominance of fossil fuels in Indonesia's electricity mix still affects the sustainability and carbon emissions of battery-powered electric vehicles (Fadhilah & Surya, 2023). This poses a significant challenge for the Indonesian government in its efforts to reduce greenhouse gas emissions through policies to develop and adopt electric vehicles (Mera & Bieker, 2023). These policies aim to accelerate the transition to a more environmentally friendly transportation system. However, Indonesia's dependence on fossil fuels, particularly coal and natural gas as the main sources of steam power plants, has the potential to reduce the effectiveness of these policies in reducing overall (Adi, 2024). The lack of transparency and availability of public information regarding the proportion of the electricity mix and the environmental impact of its production process can open up opportunities for companies engaged in the green product sector, particularly in the field of transportation (Febrianto et al., 2025).

Environmental issues have become a major determining factor in influencing changes in consumer preferences, particularly in the transport sector (Tjiwidjaja & Salima, 2023). This sector plays a significant role in contributing to global carbon emissions, with estimates that the transport sector accounts for more than 20% of total greenhouse gas emissions

worldwide. Among these transport subsectors, land transport is the largest contributor, accounting for around 90% of total transport sector emissions, making it a key focus in climate change mitigation efforts and the development of sustainable transport technologies (Fadhilah & Surya, 2023). In efforts to reduce greenhouse gas emissions, electric vehicles (EVs) are seen as a strategic solution in supporting the transition to a more sustainable and low-carbon transport system (Fitriana et al., 2020).

Electric vehicle technology offers significant potential in reducing direct emissions from the transport sector, particularly through the replacement of fossil fuel vehicles with electric-powered systems (Schiavo et al., 2021). One of China's leading electric vehicle manufacturers, BYD (Build Your Dreams), is widely known for its technological innovation and commitment to environmental sustainability. BYD entered the Indonesian market in 2019 through a strategic partnership with Bluebird Group, where 25 first-generation BYD e6 units were operated as an electric taxi fleet in the e-Bluebird service (Maghfiroh et al., 2021).

Table 1. Top 10 Best-Selling and Most Popular Electric Vehicles in Indonesia in 2024

Model	Quantity
BYD M6	6,124
Wuling Binguo EV	5,156
BYD Seal	4,828
Wuling Air EV	4,440
Chery Omoda E5	4,425
Wuling Cloud EV	3,521
BTA Atto 3	3,291
MG 4 EV	2,340
Hyundai Ioniq 5	1,561
Hyundai Kona Electric	1,196

On 18 January 2024, BYD officially launched three electric vehicle models aimed at the Indonesian consumer market, namely the BYD M6, BYD Atto 3, and BYD Seal (Huda, 2025). This launch marks BYD's strategic expansion in penetrating the electric vehicle market in Indonesia and demonstrates the company's commitment to supporting the transformation towards a sustainable transportation ecosystem at the national level (Adi, 2024). This initiative is a strategic step in encouraging the adoption of electric vehicles in Indonesia while strengthening BYD's position as one of the pioneers in the development of environmentally friendly mobility in the domestic market. This is further reinforced by the data in the table above, where BYD electric vehicles have dominated the Indonesian market by successfully placing several of its models in the list of the 10 best-selling and most sought-after electric vehicles in 2024.

Previous studies have largely examined greenwashing in the context of general eco-friendly products, primarily focusing on outcomes such as purchase intention and brand trust(Ayoub, 2024; Tu et al., 2024). However, research that specifically links greenwashing perceptions to consumer preferences in the electric vehicle sector remains limited. At the same time, well-to-wheel (WTW) emissions are predominantly addressed in technical life cycle assessment studies and are rarely incorporated as perceptual variables within marketing and consumer behaviour research (Zhang et al., 2024). Furthermore, most

empirical evidence originates from countries with advanced EV adoption, making such findings less applicable to Indonesia, where electricity generation is still heavily reliant on fossil fuels. Empirical studies that simultaneously investigate the effects of perceived greenwashing and consumer understanding of WTW emissions on EV preferences—particularly within the context of a specific brand such as BYD in Indonesia—are still scarce. This study seeks to address this gap by integrating sustainability communication and environmental performance perceptions into a unified empirical framework.

Consumer trust in sustainability claims regarding the adoption of electric vehicles, as stated by manufacturers, faces various new challenges (Li et al., 2025; Shojaei et al., 2024). The main issue that has emerged is the practice of greenwashing, which is the presentation of information of environmentally friendly claims that are not entirely accurate or tend to be misleading, thereby potentially creating a false perception among consumers regarding the actual environmental impact of the products offered (Pham & Barretta, 2024; Zioło et al., 2024). Such practices have the potential to erode the credibility and reputation of companies in the long term, especially in the context of increasing consumer criticality and awareness of sustainability claims (Mombeuil & Diunugala, 2023). Previous research on sustainability issues and consumer behaviour has focused on the influence of greenwashing on purchase intention or brand trust (Khoiriah & Imaningsih, 2025). These studies are generally limited to the context of environmentally friendly products in general and have not specifically examined how perceptions of greenwashing influence consumer preferences for electric vehicles (EVs) (Zhao et al., 2024).

H1: Greenwashing has a negative effect on consumer preferences for BYD electric vehicles

Well-to-Wheel (WTW) Emissions are considered for consumers, which is a comprehensive analytical approach used to measure the total greenhouse gas emissions produced by vehicles by considering the entire energy cycle (Ankathi et al., 2024). Well-to-Wheel (WTW) analysis consists of two main components, namely Well-to-Tank (WTT) and Tank-to-Wheel (TTW) (Prussi et al., 2020). The WTT component focuses on evaluating energy consumption and the environmental impact arising from the extraction, production, processing, and transportation of energy materials used to power vehicles. The TTW component emphasises the measurement of emissions and energy consumption that occur during the operational stage of the vehicle, namely when the energy that has been produced is used directly to generate motive power (Albatayneh et al., 2020). The combination of these two components allows for a more comprehensive assessment of a vehicle's carbon footprint and energy efficiency. This understanding plays a crucial role in shaping consumers' perceptions and levels of trust in the sustainability claims made by manufacturers, which ultimately influence consumer preferences and purchasing decisions (Diandra et al., 2023; Mera & Bieker, 2023).

H2: Well-to-wheel emissions have a positive effect on consumer preferences for BYD electric vehicles.

Social and psychological factors also play a significant role in the consumer decision-making process, both in the context of purchasing goods and services, as they influence motivation, perception, attitudes, and values that underlie consumptive behaviour towards environmentally friendly products (Peter & Vecchia, 2021). In this context, it is not only

consumers' knowledge about the products they use that plays a role, but also their level of awareness of the surrounding environment and their understanding of the long-term impacts that their consumption decisions and preferences can have (Maghfiroh et al., 2021). Environmental awareness is an important dimension in modern consumer behaviour, as it reflects individual ecological responsibility and contributes to the formation of more sustainable consumption patterns (Zhang et al., 2024). Technical aspects, such as understanding of overall energy cycle emissions or Well-to-Wheel (WTW) Emissions, are still rarely considered as variables that could potentially influence consumer decisions in choosing electric vehicles. Most empirical studies have also been conducted in countries with high EV penetration rates, such as China, the United States, and European countries, so the results cannot necessarily be generalised to the Indonesian context. Which still relies on fossil fuel power plants (Gutiérrez et al., 2024).

H3: Greenwashing and well-to-wheel emissions simultaneously have a significant effect on consumer preferences for BYD electric vehicles.
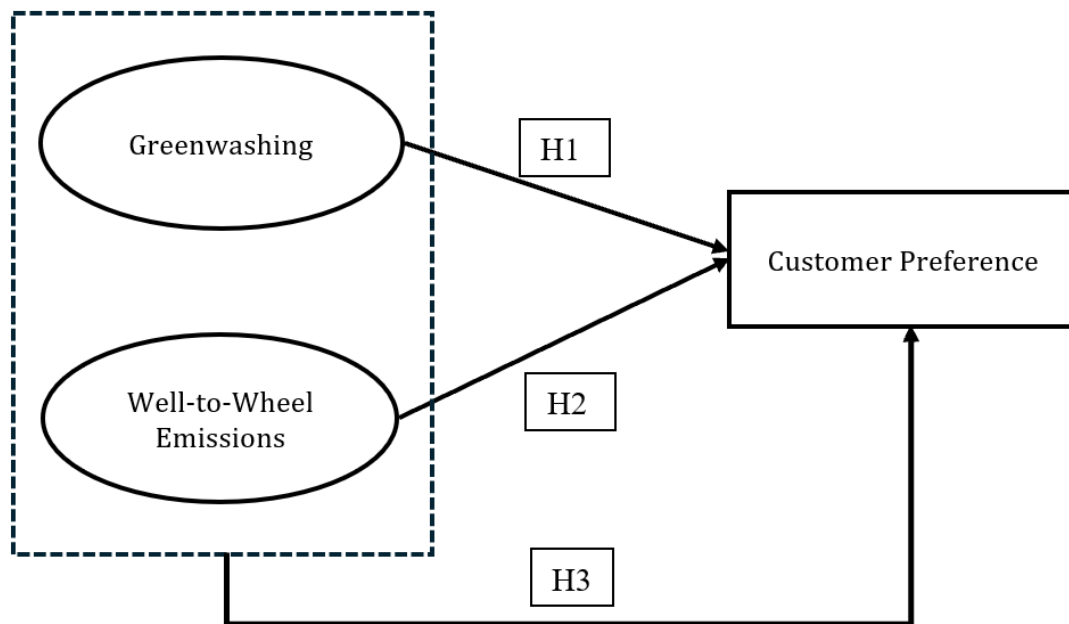

Figure 1. Conceptual Framework

Methods

This study applies a quantitative approach with a descriptive and causal design, which was chosen because it is able to measure the relationship between variables objectively, systematically, and based on empirical data. This approach allows researchers to gain an in-depth understanding of the relationship between perceptions of greenwashing and understanding of well-to-wheel emissions with consumer preferences for BYD electric vehicles. This descriptive design was used to describe the characteristics of the research variables factually, while the causal design was used to identify the cause-and-effect relationship between the variables studied. The population in this research included individuals classified as potential electric vehicle users in major cities in Indonesia,

particularly those who were familiar with the BYD brand. The sample size in this study was determined using Hair's formula because the population size could not be ascertained with certainty (Hair et al., 2024). The sample size was obtained by multiplying 12 indicators by 10, resulting in 120 respondents. The number of respondents set as the sample used a structured questionnaire using a five-point Likert scale, which was distributed online in the form of Google Forms. The respondent criteria included a minimum age of 20 years, knowledge of the BYD brand, an interest in electric vehicles, and a residence in the Greater Jakarta area and other major cities.

The data analysis technique in this study was carried out through several systematic stages, including validity testing, reliability testing, normality testing, multicollinearity testing, heteroscedasticity testing, multiple linear regression testing, and coefficient of determination testing. To analyse statistically and test the hypothesis model, the researcher used SPSS version 25 software.

Table 2. Variable Measurements

Variable	Indicator	References
Greenwashing	GW1 = I feel that BYD often exaggerates its environmental claims. GW2 = Information about the environmental impact of BYD products is not transparent. GW3 = BYD's advertising focuses more on greenwashing than on concrete evidence. GW4 = I doubt BYD's honesty in making sustainability claims.	(Pham & Barretta, 2024) (Zioło et al., 2024)
Well-to-Wheel Emissions	WTW1 = I understand the importance of emissions from the entire production process to the use of EVs WTW2 = I believe that BYD has lower total emissions than conventional vehicles. WTW3 = Total emissions information significantly influences my decision regarding BYD. WTW4 = I consider the carbon footprint from upstream to downstream when choosing a vehicle.	(Ankathi et al., 2024) (Prussi et al., 2020)
Preferensi Konsumen	CP1 = I prefer the BYD EV for environmental reasons. CP2 = I am interested in purchasing a BYD EV in the near future. CP3 = I believe that BYD is a high-quality EV brand. CP4 = I would recommend the BYD EV to others.	(Wei et al., 2021) (Diandra et al., 2023)

Results and Discussions

Based on the validity test results presented in the table below, it is known that all research instruments have a calculated r value greater than the table r, so it can be concluded that all instruments used are valid. Furthermore, the reliability test results for 120 respondents show that the Cronbach's Alpha Coefficient value is greater than 0.6, indicating that all research instruments have a good level of reliability and can be trusted for use in data collection.

Table 3. Validity Test Results

Variable	Instrument	Calculated r	Note
Greenwashing (GW)	GW1	0.784	Valid
	GW2	0.839	Valid
	GW3	0.901	Valid
	GW4	0.841	Valid
Well-to-Wheel Emissions (WTW)	WTW1	0.628	Valid
	WTW2	0.672	Valid
	WTW3	0.836	Valid
	WTW4	0.693	Valid
Consumer Preference (CP)	CP1	0.744	Valid
	CP2	0.816	Valid
	CP3	0.826	Valid
	CP4	0.878	Valid

Table 4. Reliability Test Results

Variable	Cronbach's Alpha Coefficient	Note
Greenwashing	0.863	Reliable
Well-to-Wheel Emissions	0.667	Reliable
Consumer Preference	0.831	Reliable

The results of the normality test using Kolmogorov-Smirnov show a significance value of 0.200, greater than 0.05, so the normality test on the data below can be declared normally distributed. The results of the multicollinearity test show that both independent variables have a tolerance value greater than 0.10 and a VIF value less than 10. These two results indicate that the independent variables used in this study are not correlated with each other. The scatterplot shows that the residual points are randomly scattered around the horizontal zero line without forming any particular pattern, such as clustering, widening (funnel shape), narrowing, or curving. The random and symmetrical distribution of residuals across the entire range of predicted values indicates that there is no pattern structure in the residual variance, so it can be concluded that the residual variance is constant and the regression model used does not experience heteroscedasticity.

Based on the results of the heteroscedasticity test, it is known that the significance value (Sig.) Well-to-Wheel variable is 0.910, and for the greenwashing variable is 0.356. Because both values are greater than 0.05, it can be concluded that there is no heteroscedasticity in this regression model. To determine the t-table value with a total of 120 respondents, the degrees of freedom (df) can be calculated using the formula *df = n-k*, which is 120 – 3 = 117. Based on the t-distribution table with a significance level of 0.05 and df = 117, the t-table value is 1.980. With a calculated t-value of 5.761, which is greater than the t-table value of

1.980, and a significance value of 0.000, which is less than 0.05, it can be concluded that H2 is accepted, meaning that understanding well-to-wheels emissions (WTW) has a positive and significant effect on consumer preferences (CP) for BYD electric vehicles.

The greenwashing variable also has a significance value of 0.000, which is less than 0.05, with a calculated t-value of -13.018, which is greater than the table t-value of 1.980. This means that H1 is accepted because the perception of greenwashing (GW) has a negative and significant effect on consumer preferences (CP) for BYD electric vehicles.

Table 5. t-Test Results

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	15.524	1.207		12.865	0.000
WTW	0.393	0.068	0.322	5.761	0.000
Greenwashing	-0.649	0.050	-0.727	-13.018	0.000

a. Dependent Variable: Consumer Preference

A calculated f value of 101.761, which is greater than the f table value of 3.073, and a significance value of 0.000, which is less than 0.05, it can be concluded that H3 is accepted, meaning that the perception of greenwashing (GW) and understanding of well-to-wheel emissions (WTW) simultaneously have a significant effect on consumer preferences (CP) for BYD electric vehicles.

Table 6. Results of the F Test

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	811.062	2	405.531	101.766	.000[b]
Residual	466.238	117	3.985		
Total	1277.300	119			

a. Dependent Variable: Consumer Preference
b. Predictors: (Constant), Greenwashing, WTW

The coefficient of determination test results show that the R Square value is 0.635%, which means that the simultaneous influence of greenwashing perception (GW) and well-to-wheels emissions perception (WTW) on consumer preferences (CP) for BYD electric vehicles is 63.5%, with the remainder influenced by other variables not included in this study.

The results of the study show that consumers' understanding of greenwashing negatively and significantly affects their preferences for BYD electric vehicles, which means that the first hypothesis is accepted. This is in line with research conducted by (Muflikhati et al., 2025; Bladt et al., 2024). Greenwashing has been proven to reduce consumer confidence when they are able to identify indications of manipulation in a company's environmental claims. Understanding greenwashing plays an important role in assessing how effective green marketing strategies truly are, especially in the electric vehicle sector, where brand credibility is closely tied to sustainability claims and public confidence. In this study, the findings indicate that respondents perceived a lack of transparency regarding

BYD's environmental messaging, suggesting that the company's marketing communications have not provided sufficient or clear evidence to support its sustainability assertions.

The results of the second hypothesis test show that consumer perceptions of well-to-wheels emissions have a positive and significant effect on consumer preferences for BYD electric vehicles. This is supported by research conducted by (Mera & Bieker, 2023; Zaino et al., 2024). Consumers who are highly concerned about environmental issues are more likely to evaluate vehicles based on their full energy lifecycle, including manufacturing stages, electricity generation sources, and overall energy efficiency. Such a holistic evaluation strengthens confidence in a brand and enhances its perceived value. The results of this study indicate that respondents possessed strong awareness of these aspects and showed considerable understanding of the integrated energy processes associated with BYD electric vehicles.

The third hypothesis shows that both variables, namely the perception of greenwashing and understanding of well-to-wheels emission, simultaneously and significantly influence consumer preferences, particularly towards BYD electric vehicles. This finding reflects that consumers are aware that each variable has a different but complementary influence on shaping purchasing decisions. Consumers are more inclined to favour electric vehicles when sustainability is consistently reflected across all stages of energy use, including power generation, operational efficiency, and overall emissions performance. Clear and accessible information about environmental outcomes plays a key role in building consumer confidence and shaping brand preference. When sustainability data is communicated transparently, it reinforces positive brand perceptions and strengthens the image of manufacturers such as BYD as innovators committed to environmentally responsible mobility.

Conclusion

Based on the results of analysis, testing, and discussion, this study shows that all the hypotheses proposed can be accepted. Empirical findings prove that perceptions of greenwashing practices have a negative and significant influence on consumer preferences for BYD electric vehicles. This indicates that the higher the level of consumer awareness of misleading marketing practices, the lower their level of trust and interest in the product. Conversely, a good understanding of the well-to-wheels (WTW) emissions concept has been proven to have a positive and significant effect on consumer preferences for BYD electric vehicles. This study makes an important contribution to companies engaged in the electric energy-based transportation sector, particularly in designing sustainable and ethical marketing strategies. The limitations of this study lie in the limited number of respondents and the uneven level of public knowledge about greenwashing and well-to-wheel emissions, given that the penetration of electric vehicles in Indonesia is still dominated by the middle and upper classes. Future researchs are encouraged to involve a larger and more demographically diverse sample to enhance the generalizability of the findings. In addition, subsequent research may incorporate complementary constructs such as green trust, perceived green value, environmental knowledge, and perceived sustainability value, as prior studies have demonstrated their significant influence on consumer attitudes and electric vehicle purchase decisions (Li et al., 2025; Mombeuil & Diunugala, 2023; Zhao et al., 2024).

Moreover, future research could advance the analytical framework by applying mediation or moderation models, for instance, by examining environmental awareness or energy literacy as intervening variables linking well-to-wheel emissions and consumer preferences. Employing mixed-methods or longitudinal approaches is also recommended to capture the evolving nature of consumer perceptions toward sustainability as electric vehicle adoption continues to expand in Indonesia, in line with suggestions from (Zaino et al., 2024; Oluwalana & Grzesik, 2025). Such methodological extensions are expected to provide deeper insights into consumer behaviour during the transition toward low-carbon transportation systems.

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