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A Systematic Literature Review on Consumer Preferences: Green and non-green vehicles

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Abstract
The shift in consumer buying preferences toward green vehicle can alleviate environmental degradation to a certain extent. Nevertheless, the uptake of green vehicles is still low. To understand this phenomenon, this systematic review focuses on the factors that influence consumer preferences. This study adopted the PRISMA method for the review and utilized Scopus and Web of Science as the main journal databases. The findings from this systematic review contribute to the body of knowledge by providing the basis for future research to evaluate the purchase intention of green vehicles by non-green vehicle drivers and the reasoning behind their vehicle preferences.

Keywords: systematic literature review; consumer preference; green vehicles; electric mobility

1.0 Introduction
The transportation sector has attracted much attention as one of the major sources of carbon dioxide (CO_2) emissions and global warming. The International Energy Agency in 2017 reported that the transportation sector accounted for 24 percent of all global fuel combustion-related emissions and is expected to double by 2050 (Pietzcker et al., 2014), with road transport contributing more than three-quarters or about 85 percent of these emissions (S. Wang et al., 2018). Since private vehicles constitute the largest proportion of road transport vehicles, decreasing their number, increasing the quality of vehicles, and improving energy efficiency may contribute to reducing transport emission (Solaymani, 2019; Kobashi et al., 2020). To that end, a transition towards green vehicles and moving away from the traditional internal combustion engine is a desirable outcome to mitigate the climate impacts of the road transport sector.

Due to the adverse environmental and health impacts from road transport emission, international policy such as the Paris Declaration on electromobility and climate change have gained prominence. This is to encourage nations to achieve low carbon objectives through sustainable electrification of transport. Electrification of transportation should be seen as a viable pathway to drastically reduce national CO_2 emission. The Paris Declaration pledged to have at least 20 percent of all transport vehicles to be electrically powered, and to achieve that global electric vehicle market sales need to be increased to 35 percent in 2030 (UNFCC, 2015). Additionally, the declaration substantially facilitates the global transition towards greener environment and low-carbon economies by providing shared blueprint which will benefit people, profit, and planet.

While many countries have taken proactive approach to accelerate adoption of green vehicle in developing more cleaner transportation environment, including phase-out of conventional vehicle, encourage public transportation usage, and alternative fuel vehicles innovation to substitute fossil fuel-based vehicle, the uptake of green vehicles are still slow and the transition to a low-carbon mobility remains a significant issue. The World Economic Forum (2019) reported that developed countries like the United States and Europe have less than 3 percent of electric vehicles and this figure is even lower in other regions. The slow uptake of electric vehicles is mainly explained by behavioral transformation (Susskind et al., 2020). As the emissions are contributed from daily individual activities, the repercussion from the behavioral choices can be reduced by controlling and shifting such behaviors. Nonetheless, the difficulty of transforming individual behavior seems to be the greatest challenge in breaking out of the carbon lock-in. In this sense, understanding of consumer preferences is crucial especially from the context of determining vehicle purchasing intention. Since vehicle purchasing choice is affected by many different combinations of vehicle characteristics (e.g., brand, refueling and recharging, price, etc.), the need to study consumer preferences in vehicle purchase decisions is vital (Wangsness et al., 2020). In addition, Broadbent et al., (2021) associated purchasing behavior with individuals' capabilities like; knowledge & skills, consumer attitude, social status, and financial resources. Authors also identified that government policies, vehicle characteristics, consumer attitude, perceptions and symbolism of vehicles, marketing, and innovation adoption process are influential factors in shifting consumers preferences from conventional vehicles to green vehicles. Therefore, consideration to the aforementioned factors should be given to nudge consumer preferences towards green vehicle instead of non-green vehicles.

1.1 Purpose of Study
This systematic review aims to explore the factors that motivate the choice and preference of non-green vehicle drivers when deciding between green and non-green vehicles. While there are numerous studies on the adoption of green vehicles, the research that focuses explicitly on purchase preferences of green and non-green vehicles appears to be very minimal. Therefore, this review attempts to contribute to future research on enhancing the green vehicle penetration rate and help in policy formulation to spur their uptake.

1.2 Research Question
The study attempts to answer the question: "What are the factors that influence the vehicle-purchasing preference and choice?".The remainder of the paper is structured as follows: *Section 2* presents the SLR methodology and sample identification; *Section 3* discusses the findings, and *Section 4* concludes the study and provides recommendations for future research.
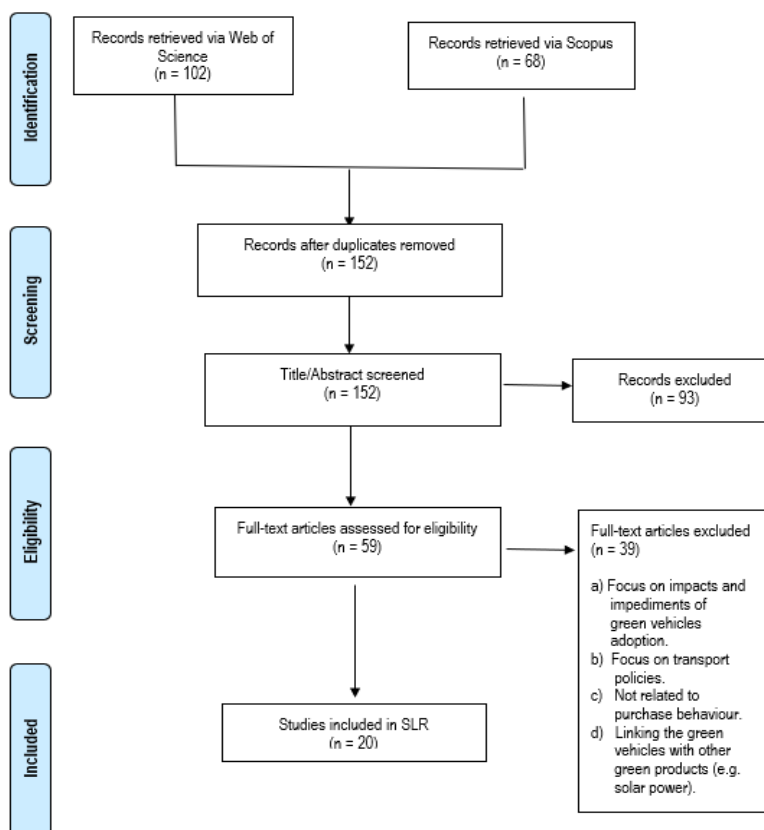
2.0 Methodology

Figure 2.1 PRISMA Flowchart
(Source: Moher et al., (2015))

The systematic review employs a Transparent Reporting of Systematic Reviews and Meta-Analyses known as Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) in favor of searching, filtering, selecting, and analyzing the research questions (PRISMA, 2015). PRISMA guidelines set up a flowchart of identification, screening, eligibility, and inclusion for the proper conduct of a systematic literature review (SLR). Scopus and Web of Science are the online databases used for this SLR.

2.1 Search Strategy
The first step of the SLR is identification. This process involves identifying the keywords used as query strings for the database search. As the aim of this paper is to find the determinants of consumer preferences between comparable electric vehicle with fossil-fueled based vehicle, therefore the choice of key terms between non-green vehicles and consumer preference are chosen to reflect the research objective. The specific search keywords are shown in Table 2.1. Additionally, the selection criteria include articles published in English and only those that are peer reviewed. Through this process, a total of 170 articles were retrieved from Scopus and Web of Science.

Table 2.1 Search Terms

Term	Query String
Consumer Preference	"consumer behavior*" OR "purchase behavior*" OR "consumer*" OR "behavior*" OR "purchase*" OR "consumer preference*" OR "consumer willingness" OR "consumer enthusiasm*" OR "consumer readiness"
Non-Green Vehicles	"non-green vehicl*" OR "non-green car*" OR "non-green transport*" OR "conventional vehicl*" OR "conventional car*" OR "conventional transport*" OR "non-hybrid vehicl*" OR "non-hybrid car*" OR "non-hybrid transport*" OR "internal combustion engine vehicl*" OR "internal combustion engine car*" OR "non-energy efficient car*" OR "non-energy efficient vehicl*" OR "fossil-fuel* vehicl*" OR "fossil-fuel* car*" OR "fossil-fuel* transport*" OR "non-electric vehicl*" OR "non-electric car*" OR "non-electric transport*"

2.2 Study Selection
Duplicate articles were removed from the list prior to the screening process, and the remaining 152 articles were considered for abstract review. After reading the title and abstract of these 152 articles, 93 were excluded as being unrelated to this SLR. The eligibility process included only the remaining 59 articles. In the eligibility process, articles which do not meet the requirement of this SLR were withdrawn. Articles that focus on electric vehicle adoption barriers and related to transport policies while not focusing on purchasing behavior were also removed. Those articles linked with other green products (e.g., solar power) were also eliminated as they are beyond this SLR's scope. In this phase, 39 articles were removed, and only 20 articles remained for the qualitative synthesis.

2.3 Thematic Analysis
Thematic analysis is an apt qualitative method to analyze the large qualitative data sets as it forces the researcher to take a well-structured approach to handling data, helping to produce a clear and organized final report. Through its theoretical freedom, thematic analysis provides a highly flexible approach that can be modified for the needs of many studies, providing a rich and detailed, yet complex account of data. This method is useful for examining the perspectives of different research participants, highlighting similarities and differences, and generating unanticipated result. The thematic analysis involves the process of discovering, analyzing, organizing, describing, and reporting themes derived from qualitative data to ensure reliable and insightful findings (Nowell et al., 2017). This paper synthesizes 20 empirical articles through thematic analysis. Twenty articles will summarize the key features to determine the central theme of the consumer preferences between green and non-green vehicles.

3.0 Findings
Adapted from Liao et al. (2017), the main themes of the green and non-green vehicles consumers' preferences are financial attributes, environmental concerns, and technical attributes. All themes are listed in Table 3.1. Each of these themes will be discussed in the next subsection.

Table 3.1 The main vehicle-purchasing preferences factors

No	Authors	Market	Financial Attributes	Environmental Concern	Technical Attributes
1	Dos Santos et al. (2021)	Europe	√		
2	Brückmann et al. (2021)	Switzerland		√	
3	Sousa et al. (2020)	Portugal	√		√
4	Wei et al. (2020)	China	√	√	√
5	Santos & Davies (2020)	Europe	√		√
6	Shetty et al. (2020)	India		√	√
7	Berneiser et al. (2020)	Germany	√		√

No.	Author	Country			
8	De Luca & Di Pace (2020)	Italy		√	√
9	Cordera et al. (2019)	Spain	√		
10	Ling et al. (2019)	China			√
11	Higueras-Castillo et al. (2019)	Spain	√		√
12	Kim & Heo (2019)	Korea	√		√
13	Shin et al. (2018)	Korea	√		√
14	Haustein & Jensen (2018)	Sweden			√
15	Liao et al. (2017)	Netherland	√		√
16	Hardman et al. (2016)	UK	√	√	
17	Rolim et al. (2014)	Portugal	√	√	
18	Hackbarth & Madlener (2013)	Germany	√	√	√
19	Caulfield et al. (2010)	Ireland	√		√
20	Choy & Prizzia (2010)	USA	√		

(Source: Author's compilation)

3.1 Financial Attributes

When considering vehicles to purchase, the cost matters the most. Financial attributes are defined as the various types of monetary cost during vehicle purchase and use. The cost may include maintenance cost, operational cost, and ownership cost. Table 3.1 shows that purchasing cost is a significant factor for vehicle-purchasing behavior. Considering the ownership cost, the purchase price of an energy-efficient vehicle is normally higher than the comparable non-green vehicle (Sousa et al., 2020; Berneiser et al., 2020; Hardman et al., 2016; Rolim et al., 2014). Apart from purchasing cost, fuel cost must also be considered while purchasing a vehicle (Caulfield et al., 2010). Consumers will consider purchasing a vehicle regardless of the variants and attributes of the vehicles if the price is about the same (Choy & Prizzia, 2010). Dos Santos et al. (2021), through the artificial neural network (ANN) model, discovered that the higher the purchase price of an internal combustion engine (ICE) vehicle, the higher probability that the consumers will opt for an electric vehicle (EV) instead. The findings of Wei et al. (2020) revealed that the preference of purchasing a vehicle differs between drivers and non-drivers of the selected vehicle. Respondents who own and drive electric cars believe that purchasing cost is the main factor when buying a vehicle rather than the one who is not. Contrary to the general perception, this study also discovered that having and maintaining the BEV is cheaper than an ICE vehicle.

In the European countries, subsidies, incentives, and tax reduction are the main tools used to reduce green vehicles' purchasing cost (Santos & Davies, 2020). The Spanish, Dutch and Austrians believe that altering the purchasing cost will be influential instrument to tilt purchasing decision. Similarly in South Korea, purchase subsidy and tax exemption are important motivational factors for green vehicle purchase behavior as the cost of having green vehicles is nearly double the cost of ICE, without the subsidy (Kim & Heo, 2019). While in Spain, Cordera et al. (2019) found that the reduction in EV's purchase price resulted in an increase of the market share. Higueras-Castillo et al. (2019) considered the effects of consumer's perceived value to the adoption of electro-mobility vehicles and relates the product's value for money with purchasing intention. The authors also added that price is generally associated with consumer's purchase satisfaction, either on monetary cost, time or effort invested in obtaining that product. All in all, the findings are as generally expected; higher purchasing cost results in lower potentials and chances of purchasing a vehicle by the typical consumer.

3.2 The Technical Attributes

Another significant factor that determines the vehicle preference is the technical characteristics of the desired vehicle. Most studies relate the vehicle's aspects and characteristics as the key drivers to motivate purchasing behavior (refer to Table 3.1). The attributes of the vehicle may include the performance and technical aspects accommodated in certain vehicles. Sousa et al. (2020) found range anxiety resulting from the limited capacity of the BEV to be the most unattractive feature of such automobiles. Therefore, the various sources of use restriction (e.g., small fuel tank, driving range and charging point's availability) are important to explore as they potentially affect consumers' preferences. Wei et al. (2020) examined the vehicles' characteristics based on demographic analysis and discovered that gender factor significantly differentiates the choice of BEV design and battery capacity. Unlike other car owners, the ones who own BEV agreed that attributes of the vehicles significantly affect their purchasing behavior. Also, the variety of green vehicles in the market (i.e., hybrid, plug-in hybrid, battery-electric and fully electric) with different characteristics and attributes require purchasers to have a certain level of knowledge prior to making the decision to own one.

A study conducted in the European region connects the vehicle attributes with the pilot/trial/demonstrations of vehicles. Sixty-six percent of respondents admitted that exposure to the features of the cars has a positive impact on buying behavior (Santos & Davies, 2020). The vehicles' functional characteristics play an essential part in the decision-making process of purchasing an automobile (Haustein & Jensen, 2018; Higueras-castillo et al., 2019; Liao et al., 2019; Shetty et al., 2020). Respondent also valued the vehicle's reliability and safety as important factors that will tilt the green vehicles purchasing behavior as an alternative to the conventional ICE (Caulfield et al., 2010). The study by Hackbarth and Madlener (2013) also revealed that consumers are willing to pay a substantial amount for the improvement of the vehicle's attributes. In addition to that, consumers also have a significantly positive preference to add

smart technology and technological advancement as part of their vehicle's attributes (Shin et al., 2018; Kim & Heo, 2019). Overall, the vehicles' features positively affect the consumer preferences.

3.3 Environmental Concerns
The adoption of green vehicles is typically linked to pro-environmental behavior. In this SLR, this factor plays a less important role in vehicles-purchasing compared to the financial attributes and technical attributes. Nevertheless, the studies by Hackbarth and Madlener (2013), Rolim et al. (2014), and Brückmann et al. (2021) confirmed that environmental concern clearly and significantly influences the adoption of green vehicles. The environmental benefit serves as a motivator in vehicle-purchase decision making (Hardman et al., 2016; Shetty et al., 2020). The pro-environmental consumer considers green vehicles as a cleaner alternative than vehicles powered by fossil fuels. In China, it is acknowledged that people who have bought BEV has a strong sense of environmental protection awareness (Wei et al., 2020). Research by De Luca and Di Pace (2020) investigates the attitudinal factors that affect the user's choice and reveals that the attitude towards the environment is statistically significant.

In general, pro-environmental consumers are inclined towards the environmental-friendly adoption intention. These consumers deliberately forgo the non-essential luxuries that will be damaging the environment and are motivated by external stimuli such as environmental pollution. Such environmentally friendly preferences may be due to the ecological values, beliefs in sustainability, and environmental consciousness. However, T. Wang et al. (2021) studies showed that due to the attitude-behavior gap, the pro-environmental attitudes may not necessarily translate into low-carbon behaviors. Other factors like comfort, convenience, and personal safety influenced their travel decision mostly. As there is no firm relationship between the environmental concerns and green vehicles adoption, further extensive study needs to be conducted to get a better picture.

4.0 Discussion
In the context of transition towards sustainability in the transportation sector, decarbonization of private vehicles appear to be a promising solution in mitigating transport emissions. Numerous studies have been conducted with the aim to understand the adoption of green vehicles. Yet, the demand for green vehicles is still underwhelming. Therefore, the findings from this SLR attempt to fill the gap between the EV's adoption and EV's low demand factors that in turn lead to the green vehicle's preferences and purchase intention.

Based on the literature reviewed by Jia (2019), the influencing factors of green vehicles adoption can be divided into demographic, situational, and psychological. Singh et al., (2020) added another contextual factor; that includes government policies and charging infrastructure. The demographic factor includes individuals and families. Situational factors are related to the performance of the vehicles (e.g., ownership cost, driving range, and environmental protection). While psychological factors are the most crucial factors, it directly affects the purchasing behavior and adoption intention. Ranjan Kumar and Alok (2019) also reviewed the adoption of EV and identified five different categories of variables; antecedents, mediator, moderator, consequences, and socio-demographics. The antecedent variables act as a motivator or barrier to the adoption (e.g., ownership cost, incentives, vehicle's performance, marketing strategies, psychological characteristics etc.) The mediator variable is the potential elements that influence antecedents, while the moderator variables affect the relationship strength between the independent and dependent variables. Socio-demographic factors on the other hand control variables that influence adoption intention depending on the regional and demographic profile. Lastly, the consequences variable is the effects of the actual adoption (i.e., environmental impacts, social impacts, and economic impacts). Adapting the framework from Ranjan Kumar and Alok (2019) and Liao et al. (2017), this research extends the body of knowledge of green vehicles adoption, by highlighting the gap between adoption factors and the actual response factors. As antecedent variables act as a nomological network, therefore understanding their correlation to consumer preference is necessary prior to conducting further study on purchase behavior.

While numerous studies focus on the adoption of green vehicles, the gap with the actual vehicle uptake is an aspect required to be studied. Bennett and Vijaygopal (2018) highlighted that the green vehicle uptake mostly depends on consumer perceptions. Other factors such as higher purchase price, lack of incentives, limited charging infrastructure are a few reasons for the low demand for EVs (Abotalebi et al., 2019). In Italy and Slovenia, Rotaris et al., (2021) found that driving range anxiety and purchasing cost play an important role in consumer decision making to vehicle purchase. Besides these two factors, Italians believed that financial incentives would have a larger impact on the growth of EV uptake compared to technological improvement (Danielis et al., 2020). In China, the cost, vehicle performance, and charging facilities are factors contributing to the low demand for green vehicles. Therefore, whilst antecedent factors are important for the adoption of electric vehicles, understanding the consumer preference between green and non-green vehicles are also required. Additionally, most of the previous studies have focused on either the antecedents or consequences with less focus on mediating or moderating variables. There are still unmapped relationships among such variables that may provide pertinent insights.

5.0 Conclusion and Recommendations
The climate change and environmental degradation awareness have been increasing in many countries over the last decade. Due to these concerns, they have changed the way consumers acknowledge and adapt to transportation innovations like the electric vehicles. This SLR explores the factors contributing to the green and non-green vehicles preferences and indirectly search for the antecedent factors that keep demand for green vehicles low. Since non-green vehicles are still dominant in road transport, this study is paramount. Based on this research, it is suggested that future research investigates other antecedent factors such as government policies, marketing strategies and charging infrastructure. More comprehensive study based on the moderating, mediating, and consequences variables

are also recommend for future exploration. In addition, the above-mentioned factors may vary depending on the geographies. Therefore, future research should be made to be more geographically diverse.

We acknowledge that this study is limited to the vehicle-preference factors to meet the objective of mitigating transport emissions. Additionally, this systematic literature review does have several important limitations. Firstly, as only English paper are reviewed, this has removed the chances of investigating possible outcomes published in other language. Secondly, the requirement of only including peer-reviewed articles has also removed important sources such as policies and report related to this topic.

Acknowledgment

Paper Contribution to Related Field of Study

The study contributes to the body of knowledge in the areas of vehicle purchase behavior, carbon emission, energy, and transport policy.

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