energies

MDPI

Review

Consumer Adoption of Electric Vehicles: A Systematic Literature Review

Paweł Bryła [1,*], Shuvam Chatterjee [2] and Beata Ciabiada-Bryła [3]

[1] Department of International Marketing and Retailing, Faculty of International and Political Studies, University of Lodz, Narutowicza 59a, 90-131 Lodz, Poland
[2] Doctoral School of Social Science, Faculty of Management, University of Lodz, Matejki 22/26, 90-297 Lodz, Poland
[3] Department of Preventive Medicine, Faculty of Health Sciences, Medical University of Lodz, Zeligowskiego 7/9, 90-752 Lodz, Poland
* Correspondence: pawel.bryla@uni.lodz.pl

Abstract: Electric vehicle (EV) disposition may challenge serious environmental issues such as excessive dependence on oil, especially in the transport sector. Despite this understanding, the adoption intention has been disappointing to date. This review tries to present a comprehensive overview of the methodologies, theories, and variables used in 57 peer-reviewed articles published between 2015 and 2022 covering the main forms of consumer adoption of EVs, consisting of purchase as well as behavioral and usage intentions. Governments may stimulate consumer adoption of EVs with exemptions on roadway tolls, convenient access to charging infrastructures, and tax and economic incentives considering energy trading and vehicle sharing. Second, it is important to create intensive awareness revolving around the EV segment. Furthermore, respecting and understanding consumer preferences would also pave the way for the success of EV acceptance. Finally, consumers' risk–benefit belief while adopting new technology will play a significant role in choosing an EV in the future, while the biggest barriers to adopting EV will be consumers' lack of confidence in EV performance, safety standard measures, and range per charge.

Keywords: electric vehicle; technology adoption; sustainable mobility; systematic literature review; consumer behavior

Citation: Bryła, P.; Chatterjee, S.; Ciabiada-Bryła, B. Consumer Adoption of Electric Vehicles: A Systematic Literature Review. *Energies* **2023**, *16*, 205. https://doi.org/10.3390/en16010205

Academic Editor: Agnieszka Izabela Baruk

Received: 29 November 2022
Revised: 21 December 2022
Accepted: 23 December 2022
Published: 25 December 2022

1. Introduction

The World Health Organization (WHO) suggests that air pollution is the biggest threat to human existence besides climate change [1]. Nine out of ten people on this globe breathe toxic air and are exposed to serious health hazards [2]. Further laboratory-tested data suggest that CO_2 emission has increased manifold in the European region [3]. Further, CO_2 emissions from fossil fuels continue to grow [4]. Transportation is by far the main cause of this kind of pollution, leading to unsustainable energy usage, having a projected increase to 50% [5] compared to the status quo of 25% worldwide CO_2 emission by 2035. De Rubens et al. [6] suggest that EVs (electric vehicles) could play a significant role in vehicle decarbonization by reducing CO_2 emissions. Lee [7] suggested that countries across the globe have taken stern measures to ensure an ending year to stop selling ICEVs (internal combustion engine vehicles). Norway and the Netherlands have kept 2025 as the deadline whereas India holds it at 2030 and France has set a goal for 2040 to encourage EVs and stop selling ICEVs.

Schneidereit et al. [8] discussed that regardless of geographic differences, similar characteristics and behaviors would be observed in EV users. However, the essence of the difference would be in the varied cross-country culture, policymaking, and different product life cycle stage [9].

In 2021, 6.5 million EVs were sold globally. The dynamics of sales were impressive (120% increase from the previous year). Currently, mainland China has the largest market share (almost 50%). The main drivers of the EV market include government policies, the Tesla effect, falling battery costs, 5G rollouts, and the launch of the Battery-as-a-Service model. The principal challenges hindering consumer adoption of EVs identified in a recent Statista report consist of lack of infrastructure (such as charging stations), high upfront costs, poor consumer knowledge and wrong perceptions, pressure from oil companies and the car manufacturer lobby, and the COVID-19 pandemic [10]. The attractiveness of EVs for consumers has increased considerably due to increased range, longer battery life, higher efficiency, and affordability. The size of the global EV market is projected to grow more than four times from 2021 to 2027 to reach approximately USD 1.4 trillion by 2027, which means an impressive compound annual growth rate (CAGR) of almost 20% [11].

This paper aims to present the results of a systematic literature review on the consumer adoption of electric vehicles. The purpose of the work is: (1) to analyze the trends in publications in this subject area with the use of selected bibliometric data (such as numbers of citations, keyword co-occurrence), (2) to identify theories, methods, and variables used in research articles on consumer adoption of EVs, (3) to summarize the main substantive findings from the state of the art of the literature, (4) to identify future research directions, and (5) to formulate guidelines for EV manufacturers and policy makers.

Our contribution to extant literature through this study is as follows:

- analysis of the research context set for understanding the consumer adoption of EVs;
- identification of the various research methodological approaches, and variables identified over the span of eight years;
- presentation of theories supporting previous research;
- formulation of future research directions.

The remainder of the paper is organized as follows. The following section presents the literature review methodology. Then, a general overview of the articles included in this review is provided with an emphasis on the bibliometric analysis. The fourth section presents the results of the meta-textual method of analysis, while Section 5 outlines the main substantive results. Section 6 summarizes the limitations and Section 7 discusses future research directions. The last section provides conclusions of this review with implications for manufacturers and policy makers.

2. Materials and Methods

The materials for this systematic literature review are the reviewed articles themselves plus selected bibliometric data concerning these articles (such as the number of publications over time and across journals, the number of citations, and keyword co-occurrence mapping).

This study followed two simple steps to narrow down the study selection (Figure 1). The first step was to select research articles using bibliographic databases such as Science Direct and Scopus. This study accommodates papers from 2015 to October 2022 using keywords including electric vehicle, adoption intentions, purchase intentions, sustainable transportation, sustainable development, electric automobiles, battery electric vehicles, technology adoption, or consumer preference, based on which 8471 articles were identified. Then, we rejected 2537 articles with the exclusion of book chapters, editorials, discussions, mini-reviews, and conference abstracts and kept only research articles. A further 1669 articles were rejected based on chosen subject areas for this study (Energy, Social Science, Environmental Science, Business Management and Accounting, Psychology) and we were left with 4265 articles. Finally, after rejecting 4090 research articles based on inappropriate titles, 175 research articles were identified to be appropriate for this study.

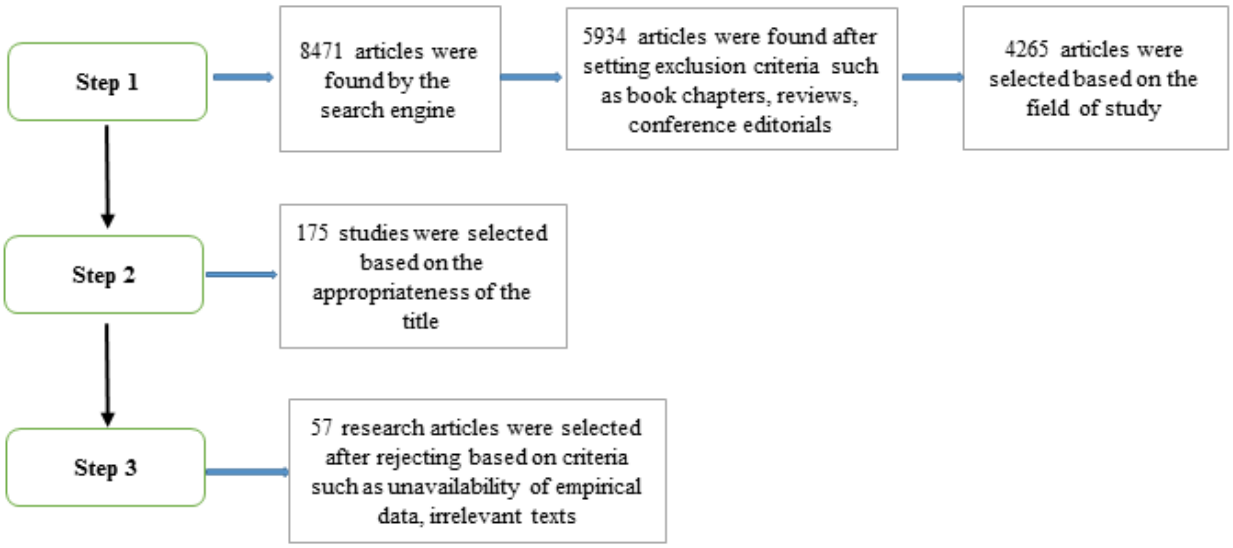

Figure 1. The article selection process for this review.

The second step was focused on analyzing these research articles based on factors such as not having the right influence on the dependent variable (adoption of electric vehicles), whether there were studies rejected on the unavailability of empirical data, articles rejected due to irrelevant texts, and finally we were left with 57 research papers eligible for this review.

Bibliometric analysis is recommended for exploring and analyzing large quantities of scientific data. It allows researchers to identify the evolutionary nuances of a research area, but its application in business studies remains limited [12]. The techniques for bibliometric analysis belong to the categories of performance analysis (e.g., the number of publications, the number of citations) and science mapping (e.g., identification of the most influential publications, co-word analysis, including keyword co-occurrence maps). Donthu et al. [12] consider bibliometric analysis as a separate type of literature review from meta-analysis and systematic literature review. In the current study, we incorporate selected elements of bibliometric analysis into our systematic literature review, as we believe this approach enhances the comprehensiveness of the review.

Small [13] suggested two approaches are used to organize research findings and conduct literature reviews on specific topics: qualitative and systematic content analysis and quantitative meta-analysis. For our study, a meta-analysis technique was carried out in the form of textual narrative synthesis. A textual combination of stories, identified and presented by Popay et al. [14] and Lucas et al. [15], characterize a standard data extraction format that allows various study characteristics (variables, methodologies, context, etc.) to be extracted from any literature. This is a bit stricter than the standard narrative ratings. Textual narrative synthesis often requires the study to be organized into more homogeneous subsets. Then, based on the extracted data, similarities and differences between studies are compared [15]. Due to the standardized coding format, the review can include a quantitative count of studies with any characteristic (e.g., publication trends, most influential articles, etc.).

3. General Overview of Articles Included in This Review

This section primarily focuses on meta-textual illustrative information about the 57 research articles included in this review. The study outlines the publication trend observed over the past eight years regarding the types of articles published along with the bibliographic analysis [16] to identify the key influential journals and articles in consumer adoption of electric vehicles across the globe.

3.1. Publication Trends

Figure 2 presents the year-wise distribution of articles witnessing a steep rise in the number of articles on electric vehicles and consumer adoption of the same, thus implying that today's consumers are becoming more and more conscious about reducing their carbon footprints through driving lower-emission vehicles in order to save this planet. The trend also demonstrates that researchers are continuously trying to influence commuters on the importance of electric vehicles considering the rise in the number of published works (47% of the total number of studies were published during the last two years).

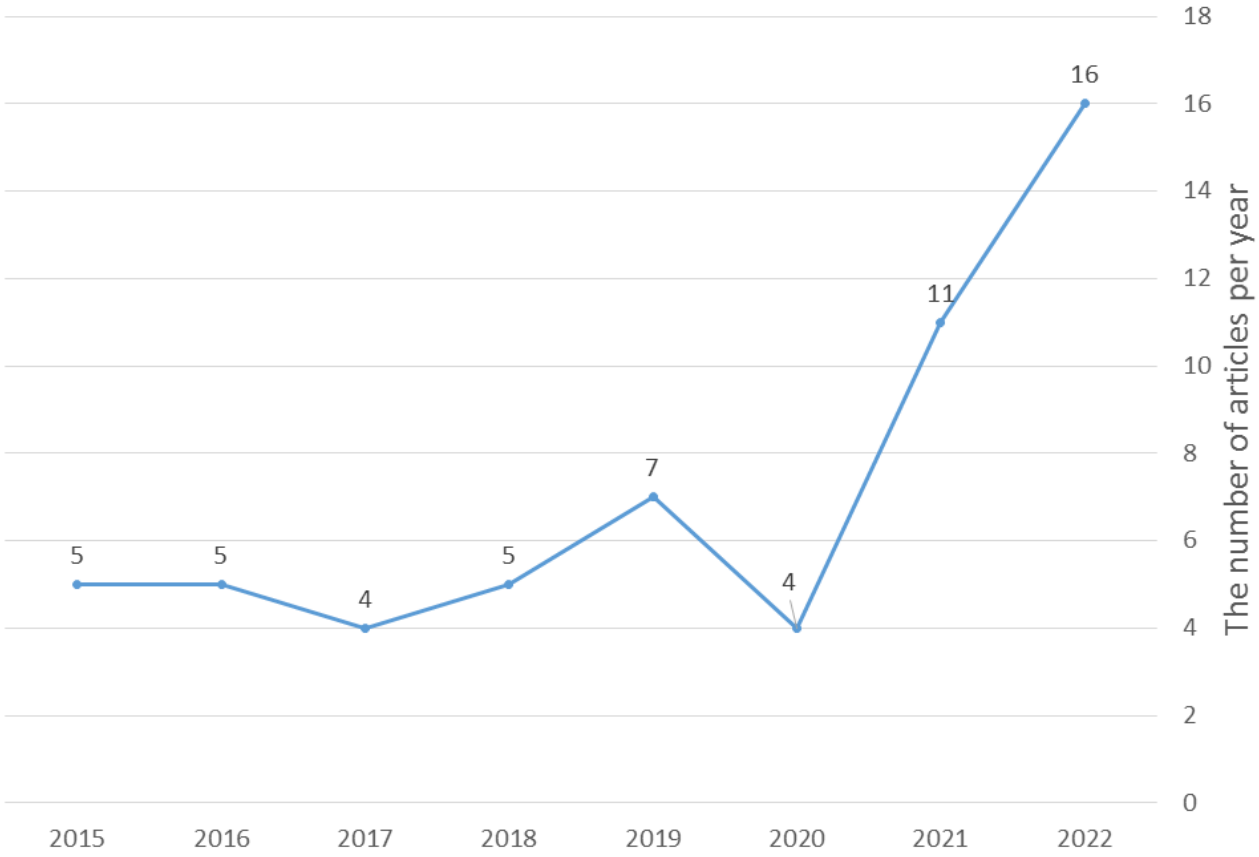

Figure 2. The number of articles included in this review by the year of publication.

3.2. Classification of Articles

Cartwright et al. [17] suggested that empirical papers are categorized either into a qualitative or quantitative or mixed method. Our study on consumer adoption of an electric vehicle is also classified into these three segments. Out of the 57 papers we studied, 6 papers were qualitative, and 7 papers adopted a mixed-method research approach. However, as many as 44 papers were based on research through a quantitative approach (Figure 3).

3.3. Bibliometric Analysis

Bibliometric analysis is a statistical method to scrutinize and outline information in specific areas of academic interest [18]. The method is adopted to identify the most influential journals, having the maximum number of citations. For our study, the journals which have contributed to this field of consumer adoption of electric vehicles are leading journals such as Technology Forecasting and Social Change, Transportation Research—Part D, Transportation Research—Part A, Journal of Cleaner Production, and Transport Policy (Table 1).

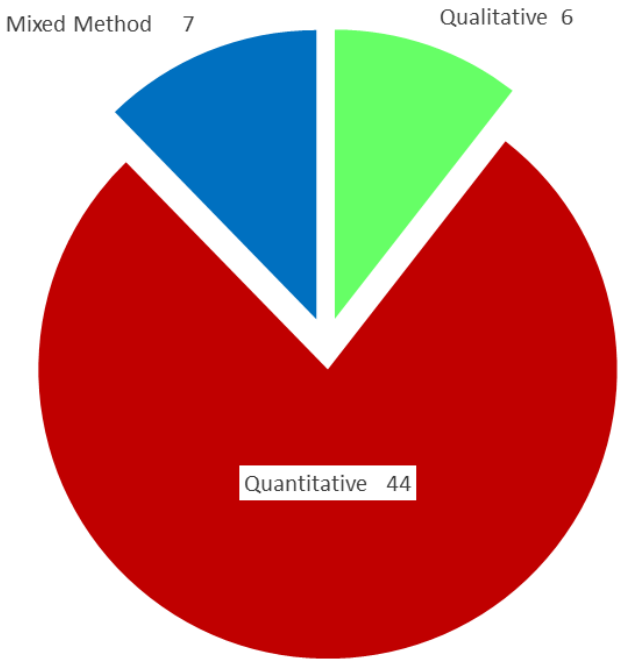

Figure 3. Articles included in the review by the applied method.

Table 1. Most influential journals in the research area under study.

Rank	Top Journals	No. of Articles	Total Citations in Google Scholar	Total Citations in WOS
1	Transportation Research—Part D	18	1025	596
2	Technology Forecasting and Social Change	6	301	167
3	Transportation Research—Part A	4	626	349
4	Energy Economics	4	31	8
5	Transportation Policy	3	431	264
6	Transportation Research—Part E	3	97	62
7	Transportation Research Procedia	3	29	11
8	Research in Transportation Economics	2	89	52
9	Energy Procedia	2	22	0
10	Renewable and Sustainable Energy Reviews	2	20	13

This review is a showcase to the fact that many sectorial and discipline-specific journals in the field of sustainable energy and transportation have made it to the list, thus hinting that EVs and their influence on consumers are being considered by governments to ensure less carbon emissions and a cleaner environment. The study also marks the most influential research articles (Table 2).

Table 2. Most influential articles.

Rank	Top Articles	Authors	Journal	Total Citations in Google Scholar)	Total Citations in WOS
1	Advances in consumer electric vehicle adoption research: A review and research agenda [19]	Rezvani, Z., Jansson, J., and Bodin, J.	Transportation Research—Part D	979	548
2	Will subsidies drive electric vehicle adoption? Measuring consumer preferences in the U.S. and China [20]	Helveston, J. P., Liu, Y., Feit, E. M., Fuchs, E., Klampfl, E., and Michalek, J. J.	Transportation Research—Part A	439	237
3	Effectiveness of incentives on electric vehicle adoption in Norway [21]	Mersky, A. C., Sprei, F., Samaras, C., and Qian, Z. S.	Transportation Research—Part D	386	206
4	What are the barriers to widespread adoption of battery electric vehicles? A survey of public perception in Tianjin, China [22]	She, Z. Y., Sun, Q., Ma, J. J., and Xie, B. C.	Transport Policy	240	146
5	Examining drivers of sustainable consumption: The influence of norms and opinion leadership on electric vehicle adoption in Sweden [23]	Jansson, J., Nordlund, A., and Westin, K.	Journal of Cleaner Production	212	121
6	Policy implications for promoting the adoption of electric vehicles: Do consumer's knowledge, perceived risk and financial incentive policy matter? [24]	Wang, S., Wang, J., Li, J., Wang, J., and Liang, L.	Transportation Research—Part A	174	105
7	Analyzing consumer attitudes towards electric vehicle purchasing intentions in Spain: Technological limitations and vehicle confidence [25]	Junquera, B., Moreno, B., and Álvarez, R.	Technology Forecasting & Social Change	165	97
8	Is awareness of public charging associated with consumer interest in plug-in electric vehicles? [26]	Bailey, J., Miele, A., and Axsen, J.	Transportation Research—Part D	113	52
9	Identifying and characterizing potential electric vehicle adopters in Canada: A two-stage modelling approach [27]	Mohamed, M., Higgins, C., Ferguson, M., and Kanaroglou, P.	Transport Policy	111	73
10	A review and simple meta-analysis of factors influencing adoption of electric vehicles [28]	Singh, V., Singh, V., and Vaibhav, S.	Transportation Research—Part D	84	44

Bibliometric analysis is a professional approach that helps researchers evaluate the progress of assigned methods by distributing data which include author affiliation, citation, and keywords via statistical techniques [29].

Mulet-Forteza et al. [30] described keyword co-occurrence analysis that generates a network of themes with their relationships that describe the conceptual area of any field. Figure 4 details the most common keywords used in these articles (e.g., EV, adoption intentions, purchase intentions, sustainable transportation, consumer adoption intentions), thus proving the fact that consumers today are more conscious about environmental hazards and are moving towards sustainable energy practices.

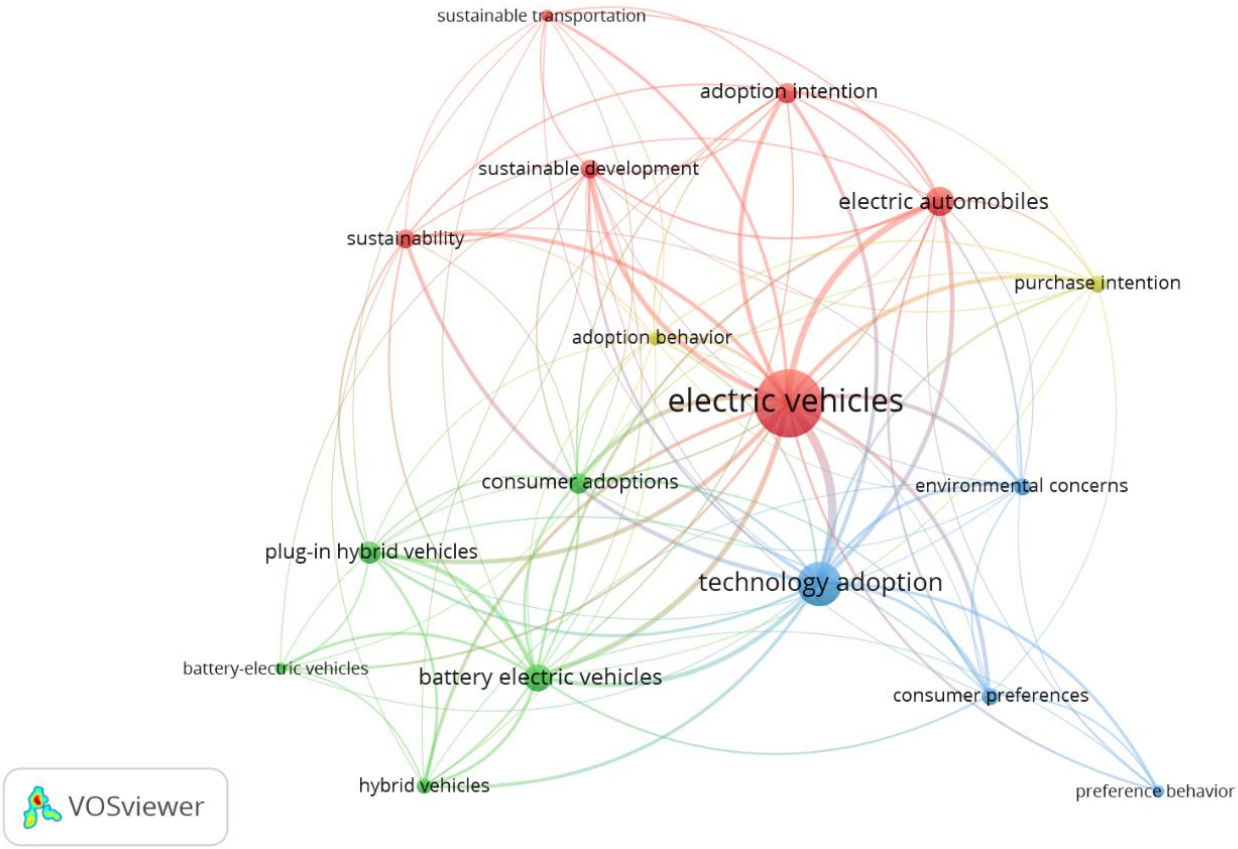

Figure 4. Co-occurrence of keyword distribution in the reviewed articles.

4. Results of the Meta-Textual Method of Analysis

4.1. Context

The following section highlights the countries involved in the analyzed sample. The findings indicate that Asia is the hub of research for the adoption of EVs contributing to this research with 30 of 61 studies included in the 57 reviewed articles, thus accounting for almost 50% of studies which qualified for this review. This signifies that Asian countries, mainly China and India, are dominating the field of consumer EV adoption trends. Europe is the second biggest contributor to this study (18 studies, almost 30% of the reviewed studies), followed by the USA and Canada (12 studies, almost 20% of the total studies), and Brazil (1 study). It is thus clear that the context of EV adoption is set in the emerging Asian markets. The feasible logic is the extensive economic and technological advancements witnessed over major Asian markets in the last eight years. The study is also an eye-opener for future researchers to tap the emerging Latin American markets. Additionally, a feasible approach would be to carry out a cross-country comparison of the adoption of EVs across selected Asian, European, and American markets (Figure 5 and Table 3).

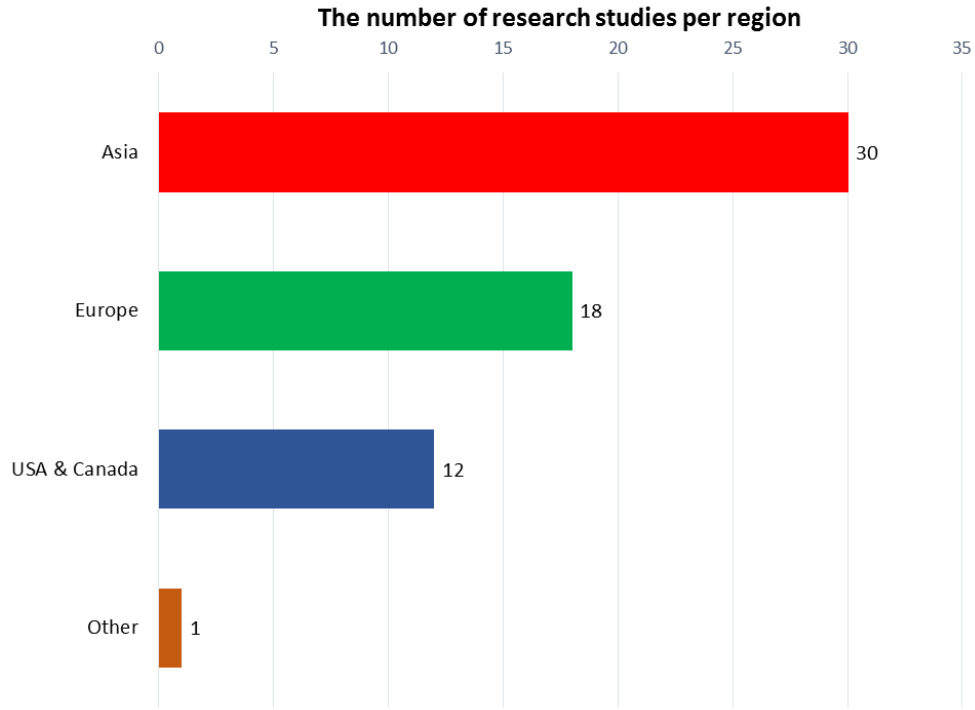

Figure 5. Research studies included in the review by region. Note: research for some articles was conducted in more than 1 country, that is why the sum is not equal to the number of articles included in the review.

Table 3. Articles included in the review by country.

Country	No. of Articles
China	17
India	9
USA	8
Canada	4
Switzerland	2
Sweden	2
South Korea	2
Germany	2
United Kingdom	2
Italy	2
Iceland	1
Norway	1
Spain	1
Pakistan	1
Belgium	1
Croatia	1
Netherlands	1
Portugal	1
Brazil	1
Russia	1
Saudi Arabia	1

Note: research for some articles was conducted in more than 1 country, that is why the sum is not equal to the number of articles included in the review.

4.2. Methods Used in the Articles Included in This Review

This section articulates the reviewed articles through the lens of the research approaches and analytical techniques adopted to highlight the relationship between EVs and consumers' adoption. Tables 4 and 5 demonstrate the data collection techniques and the analytical techniques used in consumer adoption of EV studies. Surveys are by far the

most utilized quantitative method. Other adopted methods are in-depth interviews and content analysis. Concerning the data analysis technique, structural equation modelling dominates the analyzed studies, accounting for 22% of the total studies, followed by confirmatory factor analysis, accounting for 14% of the total studies reviewed. It is also to be noted that 12% of the total studies adopted a combination of regression analysis and stated preference experiment and discreet choice modeling, or time-series analysis along with census-tract-level demographic data.

Table 4. Methods used in consumer adoption of EVs research.

Type of Articles	No. of Studies
Quantitative **Chi-square, integrated choice and latent variable model, factor analysis, Mann–Whitney equality of medians test, game theory, stochastic dynamics bi-level model, multi-criteria decision analysis, SEM, Decision-Making Trial and Evaluation Laboratory (DEMATEL) approach, choice-based conjoint analysis, t-test, stated preference choice experiment, regression, correlation, mixed logit model, latent class model**	44
Mixed Method **regression and secondary data scanning, e-mobiliTI app, stated preference experiment and discrete choice modelling, census-tract-level demographic data and time-series analysis, regression and cross-checking with local demographic data, content analysis with regression**	7
Qualitative **content analysis, in-depth interview, thematic analysis, comparative analysis**	6

Table 5. Data analysis techniques adopted in the reviewed studies.

Data Analysis Technique	No. of Articles
Structural Equation Modelling	13
Confirmatory Factor Analysis	8
Regression (incl. logistical)	6
Stated Preference Choice Experiment	5
Discrete Choice Modelling	4
Content Analysis	2
Chi-Square	2
Game Theory	2
Choice-Based Conjoint Analysis	2
Thematic Analysis	2
Census-tract-level demographic data	2
Correlation	2
Past data trends	1
Integrated choice & latent variable model	1
e-moboliTI app	1
In-depth Interview	1
Contingent Valuation Method (CVM)	1
Mann–Whitney Test	1
Stochastic dynamics model	1
Multi-criteria decision analysis & energy system model	1
Decision-Making Trial and Evaluation Laboratory (DEMATEL) approach	1
t-test	1
Difference-in-differences analysis	1
Time Series Analysis	1
Bivariate Model	1
comparative analysis	1
ANOVA	1
Mixed Logit Model	1
Latent Class Model	1

4.3. Variables Used in the Articles Included in This Review

This section reviews the various dependent, independent, control, and moderating variables used in the reviewed studies of consumer adoption of EVs (Table 6).

Table 6. Variables used in the reviewed studies on consumer adoption of electric vehicles.

Variables	No. of Studies	Examples	Contributing Theory
Independent variables			
Consumer-related	18	reasons and motivations, willingness to pay, positive attitude, perception, intent to purchase, environmental concern as a psychological factor, interpersonal relationship skills, perceived usefulness, perceived ease of use, willingness to buy, perceived risks, eWOM	Theory of Planned Behavior
Government-controlled	7	scope of investments in R&D, financial and non-financial benefits, policy mix characteristics, gasoline price, percentage of energy consumption from renewable sources, air quality impact, regulation policies, legislative support	NA
Socio-economic	2	socio-economic incentives, social network, per-capita GDP	NA
Product-related	2	prompt support in product-related technical issues, high manufacturing cost, battery warranty, depreciation rate	Random Utility Theory
Infrastructure-related	1	adequate availability of public charging stations, infrastructural scope, technology readiness index	NA
Dependent variables			
Consumer-related	20	consumer adoption intentions, consumer response, consumer interest, behavioral intentions	Theory of Reasoned Action (TRA)
Product-related	1	battery range, recharging infrastructure, technology	NA
Control variables			
Consumer-related	2	age, level of employment, employment status, education level, driving experience	Theory of Planned Behavior
Moderating variables			
Government-related	2	financial incentive policy	Technology Acceptance Model (TAM)
Consumer-related	1	personality traits of consumers	NA
Product-related	1	attribute importance	NA

4.3.1. Dependent Variables

The review investigation suggests that most of the papers have accommodated the logic behind consumer adoption of EVs in the form of consumer intentions, consumer responses, consumer interests, and behavioral perspectives for adopting EVs. Additionally, product-related factors including the battery range of the proposed EV, recharging infrastructure setup, and core technology involved with the product have contributed to forming the dependent variables.

4.3.2. Independent Variables

The independent variables largely cover consumer-related variables in the form of reasons and motivations for purchasing an electric vehicle, willingness to pay, consumer attitude, psychological factors, etc. The other form of independent variables includes socio-economic factors such as economic incentives, social networks, etc. It is closely fol-

lowed by government-controlled variables such as the scope of investments in research and development, financial and non-financial incentives, policy-mix characteristics, regulation policies, etc. The infrastructure-related independent variables include the adequate availability of public charging stations, which would play a major role in the success or failure of the adoption of electric vehicles by consumers. Lastly, we have the product attribute-related independent variables, which comprise instant support in technical issues related to the product, high manufacturing costs involved, and the battery warranty of the electric vehicle.

4.3.3. Control Variables

The control variables mostly address consumer-related factors in the form of age, level of employment, education level, driving experience, etc.

4.3.4. Moderating Variables

Finally, the moderating variables consist of consumer-related variables, such as personality traits, government-related ones in the form of financial incentives playing a crucial role in decision-making, and product-related ones as in the various attributes of the electric vehicle contributing to building its unique selling proposition in the segment.

4.4. Theories

Consumer adoption of electric vehicles has gained rapid momentum across various theoretical contexts from various disciplines. We identified 17 articles that have the theoretical backbone based on at least one theory (Table 7).

Table 7. Theories used in the reviewed studies on consumer adoption of electric vehicles.

Theories	No. of Articles	Example
Theory of Planned Behavior	6	[23,27,31–34]
Technology Acceptance Model (TAM)	3	[24,35,36]
Theory of Reasoned Action (TRA)	2	[23,37]
Theory of Hedonic Demand	1	[20]
Usage Satisfaction Theory	1	[38]
Norm Activation Model	1	[23]
Protection Motivation Theory	1	[39]
Random Utility Theory	1	[40]
Protection Action Decision Model Theory	1	[41]

5. Synthesis of the Substantive Results of the Literature Review

5.1. Factors Influencing EV Adoption

The review lists factors that have influenced consumers in their adoption intention decision for electric vehicles in the past eight years. Ahmadi et al. [42] pointed out socioeconomic factors contributing to the selection of EVs. Almansour [31] spoke about the motivation for consumers to buy EVs more from a sustainability perspective. Carley et al. [43], on the other hand, found out that the intent to buy plug-in vehicles has increased, with technology playing a major role [44]. Chu et al. [38] suggested minimized operations cost and usage satisfaction to be the determinant factors, while battery range [45] and charging infrastructure turned out to be the important reasons for dissatisfaction. Dong [46] suggested a more transparent and easier-to-adopt policy [24,47–49] and recommendations from governments [50] could encourage consumers to adopt electric vehicles. Abotalebi et al. [51] discussed purchase price, financial incentives, and lack of charging infrastructure, along with poor air quality index [52], which was further questioned by Bailey et al. [26], as the key reasons for consumer choice of EVs in certain parts of Canada. Featherman et al. [37] discussed consumer benefit appetite and willingness to buy [53,54] while facing new technologies, which accounts for a paradigm shift.

Junquera et al. [25] suggested that the consumer's perception [55], attitude [56], and motivation [36] on the price of the EV and longer charging time acted as a deterrent for considering EV purchase. It was further supported by Plananska and Gamma [57], who claimed a bundle offer comprising the EV along with a charging service promise would encourage more consumers to adopt EVs. Jansson et al. [23] considered consumers' self-image [58], interpersonal influence, and attitudinal factors became the main drivers for adopting EVs as a sustainable, eco-friendly option. Huang and Qian [59] discussed various consumer psychological factors such as car ownership symbols and risk aversions that shaped consumer preference for choosing EVs in some lower-tier cities of China. Helveston et al. [20] discussed that a government subsidy would significantly encourage consumers to adopt electric vehicles. The study by Langbroek et al. [39] illuminated how consumers who rent out their EVs have a better and clearer attitude towards their ownership. Mohamed et al. [27] identified that attitude and perceived behavior have a significant impact on behavioral intentions for adopting EVs. Ouyang et al. [60] suggested that the behavioral characteristics of consumers play a significant role in choosing an EV. Shakeel [34] suggested that cognitive consumer behavior significantly affected EV purchasing intentions for consumers along with seeking a co-adoption policy for solar charging [61,62] and the spatial effect [63].

5.2. Consumer Adoption vs. Non-Adoption Behavior for EV Usage

Chhikara et al. [64] proposed that government investments in R&D, along with financial and non-financial benefits, are the key drivers and promoters [65] for consumers' adoption intentions, while poor infrastructure and poor handling of manufacturing costs came up as the barriers [66]. Adu-Gyamfi et al. [32] proposed that consumers' adoption intentions differ based on gender and family type. Policy implications including government incentives [21] and economic incentives [67,68] play a significant role in this adoption approach behavior. Goel et al. [69] discussed that governments' unclear policies against EVs play a crucial role in holding back consumers from adopting EVs. According to Jaiswal et al. [35], consumer adoption intentions are influenced by the EV's perceived usefulness and ease of use as well as by governmental financial incentives. Huang et al. [70] observed that highly focused and educated female consumers are more eager to adopt the innovative business model of EV demonstrative policy attributes such as home charging facilities and vehicle license policies for sustainable mobility [71]. Li et al. [33] suggested how a consistent and credible policy mix greatly enhances EV adoption intentions [72] among consumers. Liao et al. [9] suggested that preference for undertaking a business model depends on vehicle types, whereas vehicle leasing emerged as more preferred for EV adoption. Ruoso and Ribeiro [73] discussed that socioeconomic conditions play a significant role in consumers' adoption confidence for the EV, and, thus, would be better suited to environmentalist consumers [74].

She et al. [22] discussed how safety, reliability, and battery range [75] per charge [76] are the factors that have raised multiple questions about non-supporting EV adoption. Will et al. [77] discussed how a well-defined framework defining the benefits of carbon-neutral charging services must be defined to allow the interests of consumers to adopt EVs.

6. Limitations

This research review has certain limitations. First, 57 articles were selected for this study only from peer-reviewed journals. Strict exclusion criteria were followed to eliminate papers from conferences and other research activities such as dissertation work. Hence, we might have missed out on a few meaningful papers published in sources other than journals and those that might have been published in other languages (than English) that could have provided insightful information on consumers' adoption of an electric vehicle. Second, the studied research papers have a methodological limitation as most of the survey respondents were yet to adopt electric vehicles. Hence, the usual concerns about self-reported data apply, especially the intention–behavior gap, as well as there is a lack of

respondents' experience with actual EVs. Third, there is no defined conceptual framework for this study, as the data were collected from secondary sources, mainly from the analysis of other researchers' results on consumer adoption of an electric vehicle.

7. Future Research Directions

Singh et al. [28] suggested that a future directive is an important perspective for any systematic review. Based on our reviews of the findings of research conducted on consumer adoption of EVs, we noted significant routes which we would highly encourage future research to take. Researchers have made noteworthy progress in understanding the factors that play a significant role in consumer adoption of electric vehicles. However, further studies could be adopted to throw more light on the following directives.

First, strict EV deployment targets are being executed which made the manufacturers focus on procuring the required raw materials for assembling at a minimum cost. MNCs are negotiating with developing nations to ensure a smooth supply of spare parts and raw material requirements to nourish electric vehicle adoption in their respective countries. Hence, future studies could be executed in emerging nations such as India and China, which are showing the world their fast and smooth process enhancement in EV adoption.

Second, just like the fast-paced, ever-changing progress in mobile phone technology, the same is being witnessed for electric vehicle adoption. Technology is rapidly progressing every single day. Hence, significant scholarly research needs to be performed in understanding EV technology attributes so that improved and well-defined targeted marketing strategies can be executed.

Third, the fact is that most of the studies tried to understand consumer purchase intentions and purchase behavior; however, very little have tried to analyze the actual usage intentions of consumers. Their future research could put more emphasis on qualitative approaches such as ZMET [78] to find out the semi-conscious metaphors which are the true drivers behind purchase intentions of EVs.

8. Conclusions

This study is an attempt to review the conditions and contexts that lead to consumer adoption of an electric vehicle. We believe that this study would encourage the scholarly community to initiate and conduct relevant research in this vital emerging research area.

The research summarizes the key findings and policy guidelines to help EV manufacturers and governments be better equipped in the future. First, governments must encourage consumers to build trust in the adoption of EVs by providing exemptions on roadway tolls, convenient access to charging infrastructures [21], and tax and economic incentives [68] considering energy trading and vehicle sharing [67]. Second, it is important to create intensive awareness revolving around the EV segment, be it adequate infrastructural setup considering charging facilities [26] or understanding the policy recommendations from governments regarding available subsidies [20,46]. Furthermore, respecting and understanding consumer preferences would also pave the way for the success of EV acceptance from manufacturers. For example, taking the pulse of consumer preference factors such as trialability and network effects [43] along with measuring the willingness to pay [79] for adopting EVs is going to play a pivotal role in EV sales. Finally, consumers' risk–benefit belief [37] while adopting new technology will play a significant role in choosing an EV in the future, while the biggest barriers to adopting EV will be consumers' unsure approach towards EV performance, safety standard measures, and range per charge [22].

Author Contributions: Conceptualization, P.B. and B.C.-B.; methodology, S.C. and P.B.; formal analysis, S.C..; writing—original draft preparation, S.C.; writing—review and editing, P.B. and B.C.-B.; visualization, P.B. and S.C.; supervision, P.B. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Data Availability Statement: Not applicable.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. WHO. Available online: https://www.who.int/news/item/22-09-2021-new-who-global-air-quality-guidelines-aim-to-save-millions-of-lives-from-air-pollution (accessed on 27 November 2022).
2. WHO. Available online: https://www.who.int/news/item/04-04-2022-billions-of-people-still-breathe-unhealthy-air-new-who-data (accessed on 27 November 2022).
3. European Commission. Available online: https://climate.ec.europa.eu/news-your-voice/news/co2-emissions-new-cars-europe-plummeted-2020-share-zero-and-low-emission-cars-tripled-2022-09-26_en (accessed on 27 November 2022).
4. Carbon Brief. Available online: https://www.carbonbrief.org/analysis-global-co2-emissions-from-fossil-fuels-hit-record-high-in-2022/ (accessed on 27 November 2022).
5. McCollum, D.L.; Wilson, C.; Bevione, M.; Carrara, S.; Edelenbosch, O.Y.; Emmerling, J. Interaction of consumer preferences and climate policies in the global transition to low-carbon vehicles. *Nat. Energy* **2018**, *3*, 664–673. [CrossRef]
6. De Rubens, G.Z.; Noel, L.; Sovacool, B.K. Dismissive and deceptive car dealerships create barriers to electric vehicle adoption at the point of sale. *Nat. Energy* **2018**, *3*, 501–507. [CrossRef]
7. Lee, J. In 2025, the price of EV will be lowered and that of internal combustion engines will be expensive. It is important to raise the market to a competitive level, without government subsidies. *Econ. Chosun* **2017**, *229*, 42–43. Available online: http://economychosun.com/client/news/view.php?boardName=C00&t_num=12704 (accessed on 27 November 2022).
8. Schneidereit, T.; Franke, T.; Günther, M.; Krems, J.F. Does range matter? Exploring perceptions of electric vehicles with and without a range extender among potential early adopters in Germany. *Energy Res. Soc. Sci.* **2015**, *8*, 198–206. [CrossRef]
9. Liao, F.; Molin, E.; van Wee, B. Consumer preferences for electric vehicles: A literature review. *Transp. Rev.* **2017**, *37*, 252–275. [CrossRef]
10. Senn-Kalb, L.; Mehta, D. *eMobility—In-Depth Market Insights & Data Analysis*; Statista: New York, NY, USA, 2022; Available online: https://www-1statista-1com-10npp4eo6211c.han3.lib.uni.lodz.pl/study/49240/emobility---market-insights-and-data-analysis/ (accessed on 20 December 2022).
11. Mordor Intelligence. (July 25, 2022). Size of the Global Market for Electric Vehicles in 2021 and 2027 (in Billion U.S. Dollars). In Statista. Available online: https://www-1statista-1com-10npp4eo6211c.han3.lib.uni.lodz.pl/statistics/271537/worldwide-revenue-from-electric-vehicles-since-2010/ (accessed on 21 December 2022).
12. Donthu, N.; Kumar, S.; Mukherjee, D.; Pandey, N.; Lim, W.M. How to conduct a bibliometric analysis: An overview and guidelines. *J. Bus. Res.* **2021**, *133*, 285–296. [CrossRef]
13. Small, H. Visualizing science by citation mapping. *J. Am. Soc. Inf. Sci.* **1999**, *50*, 799–813. [CrossRef]
14. Popay, J.; Roberts, H.M.; Sowden, A.J.; Petticrew, M.; Arai, L.; Rodgers, M.; Britten, N. Guidance on the conduct of narrative synthesis in systematic Reviews. *A Prod. ESRC Methods Programme Version 1* **2006**, *1*, b92. [CrossRef]
15. Lucas, P.J.; Baird, J.; Arai, L.; Law, C.; Roberts, H.M. Worked examples of alternative methods for the synthesis of qualitative and quantitative research in systematic reviews. *BMC Med. Res. Methodol.* **2007**, *7*, 4. [CrossRef]
16. Ferreira, F.A. Mapping the field of arts-based management: Bibliographic coupling and co-citation analyses. *J. Bus. Res.* **2018**, *85*, 348–357. [CrossRef]
17. Cartwright, S.; Liu, H.; Raddats, C. Strategic use of social media within business-to-business (B2B) marketing: A systematic literature review. *Ind. Mark. Manag.* **2021**, *97*, 35–58. [CrossRef]
18. Goyal, K.; Kumar, S. Financial literacy: A systematic review and bibliometric analysis. *Int. J. Consum. Stud.* **2020**, *45*, 80–105. [CrossRef]
19. Rezvani, Z.; Jansson, J.; Bodin, J. Advances in consumer electric vehicle adoption research: A review and research agenda. *Transp. Res. Part D Transp. Environ.* **2015**, *34*, 122–136. [CrossRef]
20. Helveston, J.P.; Liu, Y.; Feit, E.M.; Fuchs, E.; Klampfl, E.; Michalek, J.J. Will subsidies drive electric vehicle adoption? Measuring consumer preferences in the US and China. *Transp. Res. Part A Policy Pract.* **2015**, *73*, 96–112. [CrossRef]
21. Mersky, A.C.; Sprei, F.; Samaras, C.; Qian, Z.S. Effectiveness of incentives on electric vehicle adoption in Norway. *Transp. Res. Part D Transp. Environ.* **2016**, *46*, 56–68. [CrossRef]
22. She, Z.Y.; Sun, Q.; Ma, J.J.; Xie, B.C. What are the barriers to widespread adoption of battery electric vehicles? A survey of public perception in Tianjin, China. *Transp. Policy* **2017**, *56*, 29–40. [CrossRef]
23. Jansson, J.; Nordlund, A.; Westin, K. Examining drivers of sustainable consumption: The influence of norms and opinion leadership on electric vehicle adoption in Sweden. *J. Clean. Prod.* **2017**, *154*, 176–187. [CrossRef]
24. Wang, S.; Wang, J.; Li, J.; Wang, J.; Liang, L. Policy implications for promoting the adoption of electric vehicles: Do consumer's knowledge, perceived risk and financial incentive policy matter? *Transp. Res. Part A Policy Pract.* **2018**, *117*, 58–69. [CrossRef]
25. Junquera, B.; Moreno, B.; Álvarez, R. Analyzing consumer attitudes towards electric vehicle purchasing intentions in Spain: Technological limitations and vehicle confidence. *Technol. Forecast. Soc. Change* **2016**, *109*, 6–14. [CrossRef]
26. Bailey, J.; Miele, A.; Axsen, J. Is awareness of public charging associated with consumer interest in plug-in electric vehicles? *Transp. Res. Part D Transp. Environ.* **2015**, *36*, 1–9. [CrossRef]
27. Mohamed, M.; Higgins, C.; Ferguson, M.; Kanaroglou, P. Identifying and characterizing potential electric vehicle adopters in Canada: A two-stage modelling approach. *Transp. Policy* **2016**, *52*, 100–112. [CrossRef]

28. Singh, V.; Singh, V.; Vaibhav, S. A review and simple meta-analysis of factors influencing adoption of electric vehicles. *Transp. Res. Part D Transp. Environ.* **2020**, *86*, 102436. [CrossRef]
29. Koseoglu, M.A.; Rahimi, R.; Okumus, F.; Liu, J. Bibliometric studies in tourism. *Ann. Tour. Res.* **2016**, *61*, 180–198. [CrossRef]
30. Mulet-Forteza, C.; Genovart-Balaguer, J.; Mauleon-Mendez, E.; Merigó, J.M. A bibliometric research in the tourism, leisure and hospitality fields. *J. Bus. Res.* **2019**, *101*, 819–827. [CrossRef]
31. Almansour, M. Electric vehicles (EV) and sustainability: Consumer response to twin transition, the role of e-businesses and digital marketing. *Technol. Soc.* **2022**, *71*, 102135. [CrossRef]
32. Adu-Gyamfi, G.; Song, H.; Obuobi, B.; Nketiah, E.; Wang, H.; Cudjoe, D. Who will adopt? Investigating the adoption intention for battery swap technology for electric vehicles. *Renew. Sustain. Energy Rev.* **2022**, *156*, 111979. [CrossRef]
33. Li, L.; Wang, Z.; Wang, Q. Do policy mix characteristics matter for electric vehicle adoption? A survey-based exploration. *Transp. Res. Part D Transp. Environ.* **2020**, *87*, 102488. [CrossRef]
34. Shakeel, U. Electric vehicle development in Pakistan: Predicting consumer purchase intention. *Clean. Responsible Consum.* **2022**, *5*, 100065. [CrossRef]
35. Jaiswal, D.; Kaushal, V.; Kant, R.; Singh, P.K. Consumer adoption intention for electric vehicles: Insights and evidence from Indian sustainable transportation. *Technol. Forecast. Soc. Change* **2021**, *173*, 121089. [CrossRef]
36. Zhou, M.; Long, P.; Kong, N.; Zhao, L.; Jia, F.; Campy, K.S. Characterizing the motivational mechanism behind taxi driver's adoption of electric vehicles for living: Insights from China. *Transp. Res. Part A Policy Pract.* **2021**, *144*, 134–152. [CrossRef]
37. Featherman, M.; Jia, S.J.; Califf, C.B.; Hajli, N. The impact of new technologies on consumers beliefs: Reducing the perceived risks of electric vehicle adoption. *Technol. Forecast. Soc. Change* **2021**, *169*, 120847. [CrossRef]
38. Chu, W.; Im, M.; Song, M.R.; Park, J. Psychological and behavioral factors affecting electric vehicle adoption and satisfaction: A comparative study of early adopters in China and Korea. *Transp. Res. Part D Transp. Environ.* **2019**, *76*, 1–18. [CrossRef]
39. Langbroek, J.H.; Cebecauer, M.; Malmsten, J.; Franklin, J.P.; Susilo, Y.O.; Georén, P. Electric vehicle rental and electric vehicle adoption. *Res. Transp. Econ.* **2019**, *73*, 72–82. [CrossRef]
40. Li, L.; Wang, Z.; Chen, L.; Wang, Z. Consumer preferences for battery electric vehicles: A choice experimental survey in China. *Transp. Res. Part D Transp. Environ.* **2020**, *78*, 102185. [CrossRef]
41. Liu, Y.; Ouyang, Z.; Cheng, P. Predicting consumers' adoption of electric vehicles during the city smog crisis: An application of the protective action decision model. *J. Environ. Psychol.* **2019**, *64*, 30–38. [CrossRef]
42. Ahmadi, L.; Croiset, E.; Elkamel, A.; Douglas, P.L.; Entchev, E.; Abdul-Wahab, S.A.; Yazdanpanah, P. Effect of socio-economic factors on EV/HEV/PHEV adoption rate in Ontario. *Technol. Forecast. Soc. Change* **2015**, *98*, 93–104. [CrossRef]
43. Carley, S.; Siddiki, S.; Nicholson-Crotty, S. Evolution of plug-in electric vehicle demand: Assessing consumer perceptions and intent to purchase over time. *Transp. Res. Part D Transp. Environ.* **2019**, *70*, 94–111. [CrossRef]
44. Lim, D.J.; Jahromi, S.R.; Anderson, T.R.; Tudorie, A.A. Comparing technological advancement of hybrid electric vehicles (HEV) in different market segments. *Technol. Forecast. Soc. Change* **2015**, *97*, 140–153. [CrossRef]
45. Lebeau, P.; Macharis, C.; Van Mierlo, J. Exploring the choice of battery electric vehicles in city logistics: A conjoint-based choice analysis. *Transp. Res. Part E Logist. Transp. Rev.* **2016**, *91*, 245–258. [CrossRef]
46. Dong, Y. Analysis of Consumers' Willingness to Accept of Government Subsidies for Electric Vehicles. *Transp. Res. Procedia* **2022**, *61*, 90–97. [CrossRef]
47. Dua, R.; Hardman, S.; Bhatt, Y.; Suneja, D. Enablers and disablers to plug-in electric vehicle adoption in India: Insights from a survey of experts. *Energy Rep.* **2021**, *7*, 3171–3188. [CrossRef]
48. Fazeli, R.; Davidsdottir, B.; Shafiei, E.; Stefansson, H.; Asgeirsson, E.I. Multi-criteria decision analysis of fiscal policies promoting the adoption of electric vehicles. *Energy Procedia* **2017**, *142*, 2511–2516. [CrossRef]
49. Secinaro, S.; Calandra, D.; Lanzalonga, F.; Ferraris, A. Electric vehicles' consumer behaviours: Mapping the field and providing a research agenda. *J. Bus. Res.* **2022**, *150*, 399–416. [CrossRef]
50. Srivastava, A.; Kumar, R.R.; Chakraborty, A.; Mateen, A.; Narayanamurthy, G. Design and selection of government policies for electric vehicles adoption: A global perspective. *Transp. Res. Part E Logist. Transp. Rev.* **2022**, *161*, 102726. [CrossRef]
51. Abotalebi, E.; Scott, D.M.; Ferguson, M.R. Why is electric vehicle uptake low in Atlantic Canada? A comparison to leading adoption provinces. *J. Transp. Geogr.* **2019**, *74*, 289–298. [CrossRef]
52. Nichols, B.G.; Kockelman, K.M.; Reiter, M. Air quality impacts of electric vehicle adoption in Texas. *Transp. Res. Part D Transp. Environ.* **2015**, *34*, 208–218. [CrossRef]
53. Irfan, M.; Ahmad, M. Relating consumers' information and willingness to buy electric vehicles: Does personality matter? *Transp. Res. Part D Transp. Environ.* **2021**, *100*, 103049. [CrossRef]
54. Nazari, F.; Rahimi, E.; Mohammadian, A.K. Simultaneous estimation of battery electric vehicle adoption with endogenous willingness to pay. *ETransportation* **2019**, *1*, 100008. [CrossRef]
55. Zhang, W.; Wang, S.; Wan, L.; Zhang, Z.; Zhao, D. Information perspective for understanding consumers' perceptions of electric vehicles and adoption intentions. *Transp. Res. Part D Transp. Environ.* **2022**, *102*, 103157. [CrossRef]
56. Wu, J.; Liao, H.; Wang, J.W. Analysis of consumer attitudes towards autonomous, connected, and electric vehicles: A survey in China. *Res. Transp. Econ.* **2020**, *80*, 100828. [CrossRef]
57. Plananska, J.; Gamma, K. Product bundling for accelerating electric vehicle adoption: A mixed-method empirical analysis of Swiss customers. *Renew. Sustain. Energy Rev.* **2022**, *154*, 111760. [CrossRef]

58. Li, L.; Wang, Z.; Gong, Y.; Liu, S. Self-image motives for electric vehicle adoption: Evidence from China. *Transp. Res. Part D Transp. Environ.* **2022**, *109*, 103383. [CrossRef]
59. Huang, Y.; Qian, L. Consumer preferences for electric vehicles in lower tier cities of China: Evidences from south Jiangsu region. *Transp. Res. Part D Transp. Environ.* **2018**, *63*, 482–497. [CrossRef]
60. Ouyang, D.; Zhang, Q.; Ou, X. Review of market surveys on consumer behavior of purchasing and using electric vehicle in China. *Energy Procedia* **2018**, *152*, 612–617. [CrossRef]
61. Liang, J.; Qiu, Y.L.; Xing, B. Impacts of the co-adoption of electric vehicles and solar panel systems: Empirical evidence of changes in electricity demand and consumer behaviors from household smart meter data. *Energy Econ.* **2022**, *112*, 106170. [CrossRef]
62. Moon, S.; Lee, J.; Choi, H.; Woo, J. Impact of energy production mix on alternative fuel vehicle adoption in Korea. *Transp. Res. Part D Transp. Environ.* **2022**, *105*, 103219. [CrossRef]
63. Liu, X.; Roberts, M.C.; Sioshansi, R. Spatial effects on hybrid electric vehicle adoption. *Transp. Res. Part D Transp. Environ.* **2017**, *52*, 85–97. [CrossRef]
64. Chhikara, R.; Garg, R.; Chhabra, S.; Karnatak, U.; Agrawal, G. Factors affecting adoption of electric vehicles in India: An exploratory study. *Transp. Res. Part D Transp. Environ.* **2021**, *100*, 103084. [CrossRef]
65. Kumar, R.R.; Chakraborty, A.; Mandal, P. Promoting electric vehicle adoption: Who should invest in charging infrastructure? *Transp. Res. Part E Logist. Transp. Rev.* **2021**, *149*, 102295. [CrossRef]
66. Krishna, G. Understanding and identifying barriers to electric vehicle adoption through thematic analysis. *Transp. Res. Interdiscip. Perspect.* **2021**, *10*, 100364. [CrossRef]
67. Meisel, S.; Merfeld, T. Economic incentives for the adoption of electric vehicles: A classification and review of e-vehicle services. *Transp. Res. Part D Transp. Environ.* **2018**, *65*, 264–287. [CrossRef]
68. Falbo, P.; Pelizzari, C.; Rizzini, G. Optimal incentive for electric vehicle adoption. *Energy Econ.* **2022**, *114*, 106270. [CrossRef]
69. Goel, P.; Sharma, N.; Mathiyazhagan, K.; Vimal, K.E.K. Government is trying but consumers are not buying: A barrier analysis for electric vehicle sales in India. *Sustain. Prod. Consum.* **2021**, *28*, 71–90. [CrossRef]
70. Huang, Y.; Qian, L.; Soopramanien, D.; Tyfield, D. Buy, lease, or share? Consumer preferences for innovative business models in the market for electric vehicles. *Technol. Forecast. Soc. Change* **2021**, *166*, 120639. [CrossRef]
71. Cellina, F.; Cavadini, P.; Soldini, E.; Bettini, A.; Rudel, R. Sustainable mobility scenarios in southern Switzerland: Insights from early adopters of electric vehicles and mainstream consumers. *Transp. Res. Procedia* **2016**, *14*, 2584–2593. [CrossRef]
72. Encarnação, S.; Santos, F.P.; Santos, F.C.; Blass, V.; Pacheco, J.M.; Portugali, J. Paths to the adoption of electric vehicles: An evolutionary game theoretical approach. *Transp. Res. Part B Methodol.* **2018**, *113*, 24–33. [CrossRef]
73. Ruoso, A.C.; Ribeiro, J.L.D. The influence of countries' socioeconomic characteristics on the adoption of electric vehicle. *Energy Sustain. Dev.* **2022**, *71*, 251–262. [CrossRef]
74. Salari, N. Electric vehicles adoption behaviour: Synthesising the technology readiness index with environmentalism values and instrumental attributes. *Transp. Res. Part A Policy Pract.* **2022**, *164*, 60–81. [CrossRef]
75. Zhao, X.; Ma, Y.; Shao, S.; Ma, T. What determines consumers' acceptance of electric vehicles: A survey in Shanghai, China. *Energy Econ.* **2022**, *108*, 105805. [CrossRef]
76. Tiwari, V.; Aditjandra, P.; Dissanayake, D. Public attitudes towards electric vehicle adoption using structural equation modelling. *Transp. Res. Procedia* **2020**, *48*, 1615–1634. [CrossRef]
77. Will, C.; Lehmann, N.; Baumgartner, N.; Feurer, S.; Jochem, P.; Fichtner, W. Consumer understanding and evaluation of carbon-neutral electric vehicle charging services. *Appl. Energy* **2022**, *313*, 118799. [CrossRef]
78. Chatterjee, S.; Kundu, A. Sub-conscious decision mapping and network framework for retail market consumption. *Indian J. Mark.* **2020**, *50*, 35–51. [CrossRef]
79. Bansal, P.; Kumar, R.R.; Raj, A.; Dubey, S.; Graham, D.J. Willingness to pay and attitudinal preferences of Indian consumers for electric vehicles. *Energy Econ.* **2021**, *100*, 105340. [CrossRef]