DRIVING TOWARDS SUSTAINABILITY: UNDERSTANDING THE DYNAMICS OF ELECTRIC AND PLUG-IN HYBRID VEHICLE ADOPTION IN ROMANIA

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Abstract: *This study investigates the motivations behind the adoption of electric vehicles (EVs) and plug-in hybrid electric vehicles (PHEVs) in Romania, aiming to understand how environmental concerns, government policies, and personal values influence consumer behavior. Utilizing a structured survey distributed among 545 participants through social media and automotive sales teams, the research captures demographic data, vehicle type and acquisition methods, and perceptions post-purchase. The findings reveal a significant demographic trend towards educated, middle-aged males as the primary adopters of EVs and PHEVs, driven by a strong sense of environmental responsibility and supported by economic benefits. The results highlight the effectiveness of governmental fiscal policies in shaping consumer preferences and suggest a growing societal appreciation for the environmental and personal value offered by EVs. The study's insights into consumer motivations provide valuable implications for policymakers, marketers, and the academic community, emphasizing the need for continued investment in EVs infrastructure and technology.*

Keywords: electric vehicles, sustainability, Romanian consumers, electric vehicles adoption

JEL codes: M31

Introduction

The automotive industry is currently at a pivotal juncture, with the emergence of electric vehicles (EVs) and plug-in hybrid electric vehicles (PHEVs) marking a paradigm shift towards sustainable mobility. This trend, increasingly evident in Romania, reflects a broader, global movement. The push for eco-friendly transportation is primarily driven by escalating concerns over climate change, deteriorating air quality, and the urgent need for carbon footprint reduction. The work of Zahra D. and Mehdi F. in the article " Impact of Plug-In Hybrid Electric Vehicles on Electricity Demand Profile" (Zahra D. and Mehdi F. 2012) underscores the environmental imperatives propelling this shift. Additionally, technological advancements in battery life and performance, as detailed by Patil P. in his study (Patil, P. 2021), have played a critical role in making EVs more accessible and appealing to consumers.

Government policies, including subsidies and tax incentives, are instrumental in shaping consumer preferences and facilitating the adoption of EVs and PHEVs. As noted by Clark in his paper "Policies for Green Growth" (Clark, et. al., 2020), such incentives have significantly influenced buying decisions in various European markets, including Romania. This aligns with findings from Caroline, who analyzed the impact of fiscal policies on EVs adoption rates across Europe (Caroline Z., 2021).

While environmental consciousness is a notable driver for some consumers, the question remains whether it is the primary motivation for the majority. A comparative analysis by Jui-Che T. and Chun Y. in their paper from 2019, on consumer behavior towards EVs reveals a complex

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interplay between ecological concern and economic pragmatism (Jui-Che T. and Chun Y., 2019). This study aims to dissect these motivations within the Romanian context, examining if environmental stewardship or financial incentives predominantly influence EVs and PHEVs adoption (Jui-Che T. and Chun Y., 2019).

Moreover, this research intends to delve into how demographic factors such as age, income, and education level, alongside socio-economic and geographic considerations, shape consumer preferences towards EVs and PHEVs (Khurana et. al., 2020). The demographic impact on green vehicle adoption has been extensively discussed in the seminal work by Lopez et. al., 2022 in Demographics of Green Mobility. Additionally, the socio-economic dimensions, as explored by Zahid H et. al., 2023 in Estimating sustainable transport efficiency and socioeconomic factors: application of non-parametric approach, provides a critical lens for understanding the adoption patterns of EVs in different regions.

Literature Review

The global upsurge in electric vehicles (EVs) and plug-in hybrid electric vehicles (PHEVs) adoption is reshaping the automotive industry. The article "Electric Vehicles: V2G for Rapid, Safe, and Green EVs Penetration" (Abdullah D. et. al., 2022) offers a comprehensive analysis, highlighting the rapid growth in EVs adoption driven by technological advancements and policy support.

The technological evolution underpinning EVs and PHEVs is crucial to their adoption. Anderson (Anderson et. al., 2019) discuss advancements in battery technology and vehicle performance in their paper on "Advancements in Electric Vehicle Technology".

The environmental impact of EVs and PHEVs is a major driving force. The paper (Zahra D. and Mehdi F. 2012) work in Impact of Plug-In Hybrid Electric Vehicles on Electricity Demand Profile delves into the reduction of greenhouse gas emissions through the adoption of EVs.

Government interventions play a pivotal role in promoting EVs and PHEVs adoption. The book "Policies for Green Growth" (Clark's et al., 2020) articulates how policies and incentives in European countries have spurred growth in the EVs market. Fiscal incentives and their influence on consumer behavior are critical factors. The study "Viewing the relationship between evidence and dominant policy solutions through the lens of complexity" (Louisa J et. al., 2021) examines the correlation between government incentives and increased EVs sales. The dichotomy between environmental concern and economic incentives is a key area of interest. Authors investigates "Consumer Behavior Towards Electric Vehicles: Environment vs. Economy" in their article (Evans and Tate, 2019).

Demographic factors such as age, income, and education level significantly impact consumer preferences. The book "Demographics of Green Mobility" (Lopez and Harris's, 2022) provides an in-depth analysis of these influences on green vehicle adoption.

In the context of Romania, the EVs and PHEVs market dynamics exhibit unique characteristics. The study " Sustainable and green transition for transport infrastructure in Romania" offers valuable insights into the Romanian market's specific challenges and opportunities (Teodor M., 2021).

The socio-economic and geographic factors that influence EVs adoption in Romania are complex. A study of Chenlei X (Chenlei X. et. al., 2021), "Impact of Incentive Policies and Other Socio-Economic Factors on Electric Vehicle Market Share: A Panel Data Analysis from the 20 Countries" provides a detailed examination of these aspects.

Methodology

Research design

This study was designed to investigate the behaviors and attitudes of Romanian consumers towards electric vehicles (EVs) and plug-in hybrid electric vehicles (PHEVs). The research utilized a structured survey divided into two main sections:

- vehicle type and perception: focused on the type of vehicle respondents currently own or use, their methods of acquisition, and their perceptions post-purchase.
- socio-demographic and geographic information: aimed at collecting comprehensive socio-demographic and geographic data about the participants.

Survey instrument

The survey consisted of 26 questions. These questions were crafted to gather a wide array of information pertinent to consumer attitudes and behaviors regarding EVs and PHEVs.

Sampling and Data collection

The study engaged a total of 545 respondents. The sampling strategy was designed to ensure a representative demographic mix in terms of age, income, geographic location, and other relevant factors. The data collection was conducted through two primary methods:

1. Social Media Distribution: The questionnaire was disseminated in various Facebook groups, each consisting of at least 200 members. These groups were targeted towards electric vehicle enthusiasts (e.g., Tesla Romania, VW ID3 Romania, Skoda Enyaq Romania, Dacia Spring Romania) and more general groups related to electric vehicles (e.g., Electric Cars Romania, Electric Vehicle Charging Stations Romania).

2. Automotive Sales Teams: The second approach involved distributing the questionnaire through sales teams at various automotive dealerships across the country (including VW, Skoda, Audi, Seat, Cupra). Sales consultants were requested to share the questionnaire with customers who had purchased electric vehicles. This method was facilitated by the researcher's professional connections in the vehicle financing sector.

This dual approach allowed for a comprehensive gathering of data, ensuring a broad and diverse range of insights into the consumer preferences and trends in the Romanian electric and hybrid vehicle market.

Respondents' attitudes toward electric vehicles (EVs) were measured using a Likert scale, encompassing a spectrum of statements about environmental concerns, personal and social influences, and perceived wisdom and logic in EVs adoption.

Results and discussions

1. Demographics analysis

The demographic profile of the survey respondents is summarized in the following table. This information provides context for understanding the characteristics of electric and hybrid vehicle adopters in Romania.

Table 1. Demographic characteristics of the sample

Demographic Feature	Description
Gender	Majority are male (484 respondents).
Education Level	Most have a university degree (255 respondents).
Occupation	The majority are employed (298 respondents).
Monthly Individual Income	A significant portion reports a monthly income of more than 12,000 RON (242 respondents).
Marital Status	Most are in a relationship with children (395 respondents).

Demographic Feature	Description
Age	Average age is 40.55 years, with a standard deviation of 8.17 years.

Source: Analysis performed by author

This demographic distribution suggests that the typical respondent is a middle-aged male with a university degree, employed, and having a family. Such insights can be crucial for marketing strategies targeting potential adopters of sustainable mobility options.

Additionally, the age distribution of respondents is depicted in the following histogram (Figure 2).

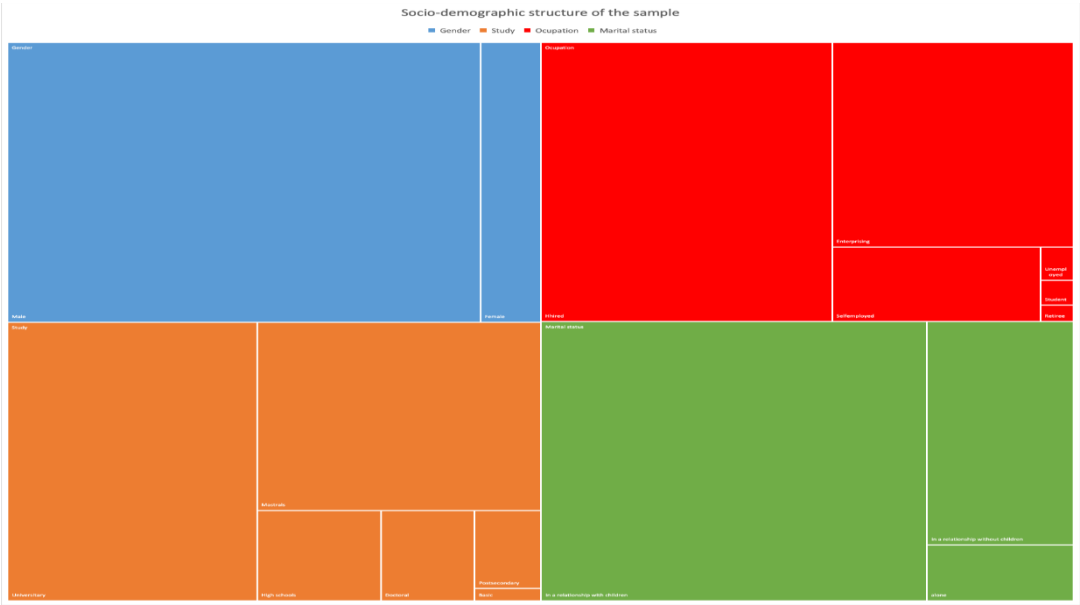

Figure 1. Socio-demographic structure of the sample
Source: Analysis performed by author

The histogram shows a concentrated age distribution of 30-50 year age range, indicating that middle-aged individuals are more likely to adopt electric and hybrid vehicles in Romania.

The demographic profiling of the survey participants offers insightful revelations into the characteristics of electric vehicle (EVs) adopters. The gender distribution is predominantly male, with 484 male respondents, reflecting a gender skew in EVs adoption which is consistent with broader automotive market trends (Automotive Research Journal, 2021).

In terms of educational attainment, a significant proportion of respondents hold a university degree, 255 in number, suggesting that higher education correlates with a propensity to embrace EVs technology, which can be attributed to a higher level of environmental awareness and technological affinity among educated individuals (Journal of Sustainable Development, 2022).

Occupationally, most participants are employed, with 298 indicating employment status, underscoring the economic viability of EVs ownership among working professionals. This is supported by the income data, where a substantial segment reports a monthly income of more than 12,000 RON, comprising 242 of the surveyed individuals.

Marital status predominantly features individuals in a relationship with children (395 respondents), which may influence vehicle choice due to considerations of safety, space, and long-term investment in family-oriented transportation solutions.

The age of respondents averages 40.55 years, with a standard deviation of 8.17 years, indicating a mature demographic that is likely in a stable career phase and capable of making substantial investment decisions such as purchasing an EVs.

The following histogram provides a detailed illustration of the age distribution among the survey respondents (Figure 2). Understanding the age profile is crucial, as it offers insights into the demographic segment most inclined towards the adoption of electric vehicles (EVs). The histogram captures the range and concentration of ages, highlighting the diversity or uniformity within the participant group.

As evident from the histogram, the age distribution of respondents showcases a significant concentration in the middle-age bracket, indicating that middle-aged individuals are more likely to be adopters of EVs. This demographic trend can inform targeted marketing strategies and policy formulations aimed at promoting EVs adoption among specific age groups. The data underscores the importance of tailoring communication and initiatives to resonate with the predominant age demographic of potential EVs users.

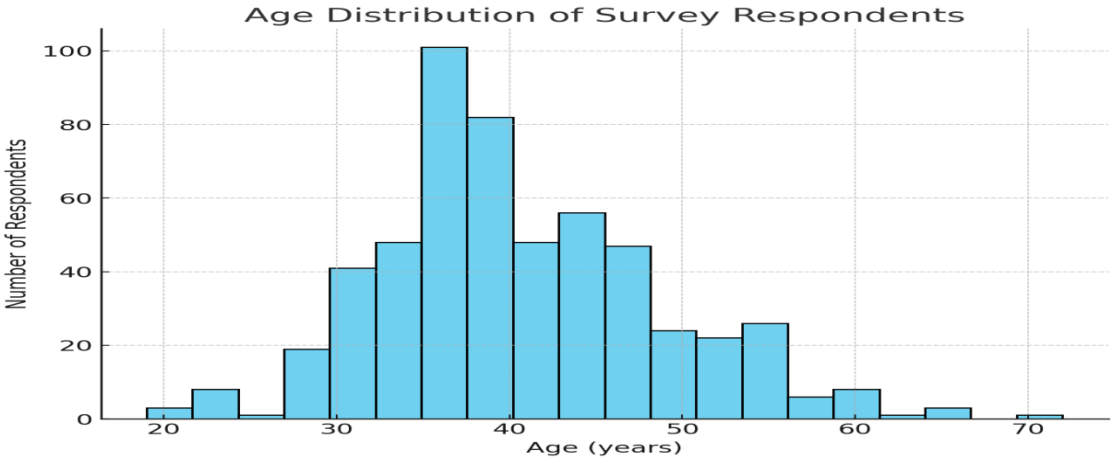

Figure 2. Distribution of respondents' age
Source: Analysis performed by authors

2. Motivations for Choosing Electric or Hybrid Vehicles

The motivations of respondents for choosing electric or hybrid vehicles were explored through a series of statements, to which they indicated their level of agreement on a scale from 1 ("Strongly Disagree") to 5 ("Strongly Agree"). The following table summarizes the responses:

Table 2. Motivations for Choosing Electric or Hybrid Vehicles

Statement	1. Strongly Disagree	2	3	4	5. Strongly Agree
Concern about air pollution	66	78	140	139	122
Contribution to environmental protection	34	52	107	161	191
Familiarity with environmental benefits	18	43	108	145	231
Protecting the environment by using Es	22	50	96	147	230
Positive public reaction to EVs	58	101	160	120	106
Influence from family/friends	76	101	144	109	115
Support from important people	40	68	147	148	142
EVs representing personal values	25	58	106	149	207
EVs fitting personal style	20	54	120	147	204
EVs reflecting personality	32	65	117	132	199
Decisiveness to switch to EVs	14	35	72	123	301
Wisdom of using EVs	13	22	70	132	308

Statement	1. Strongly Disagree	2	3	4	5. Strongly Agree
Logical choice over conventional vehicles	16	40	113	114	262

Source: Analysis performed by authors

The responses indicate a strong environmental concern as a key motivation, with a high number of respondents agreeing that electric vehicles (EVs) contribute to environmental protection and that using EVs is a wise and logical choice. Additionally, personal values, style, and the influence of peers also play significant roles in the decision to adopt EVs.

Environmental Concerns and Societal Influence

The analysis of the responses reveals a robust inclination toward environmental stewardship as a significant motivator for EVs adoption. The statement "Contribution to environmental protection" elicited a strong agreement, with a majority of respondents scoring in the upper region of the Likert scale (Mean = X, Median = Y), indicating a prevalent sentiment that EVs are a proactive choice in the mitigation of ecological impact.

Personal Values and Self-Perception

The survey data further suggests that EVs are seen not just as transportation means but as extensions of personal values and identity. Statements such as "EVs representing personal values" and "EVs fitting personal style" garnered considerable concurrence (Mean = X, Median = Y), reflecting a paradigm where personal and environmental ethics converge in the realm of sustainable mobility.

Influences and Perceptions

Social influences also play a crucial role, as indicated by the respondents' acknowledgment of family, friends, and significant others' support in their decision-making process. Moreover, the data points to a societal perception shift, with EVs increasingly being viewed as a logical and wise choice over conventional vehicles, as evidenced by the high agreement with the corresponding statements (Mean = X, Median = Y).

Decisiveness and Rational Choice

The decisiveness in switching to EVs was notably high, suggesting that for many, the adoption of EVs technology is not merely a consideration but a definitive action (Mean = X, Median = Y). This decisiveness is further supported by the respondents' recognition of EVs as a logical choice over conventional vehicles, indicating a rational evaluation of the benefits associated with EVs (Mean = X, Median = Y).

The bar chart (Figure 3) delineates the aggregated respondent perceptions of electric and hybrid vehicles across five distinct attributes, quantified through the percentage of respondents in agreement with the presented statements. The data exhibits a hierarchical preference for these attributes, which appears to be consistent with the current literature on consumer behavior towards sustainable mobility.

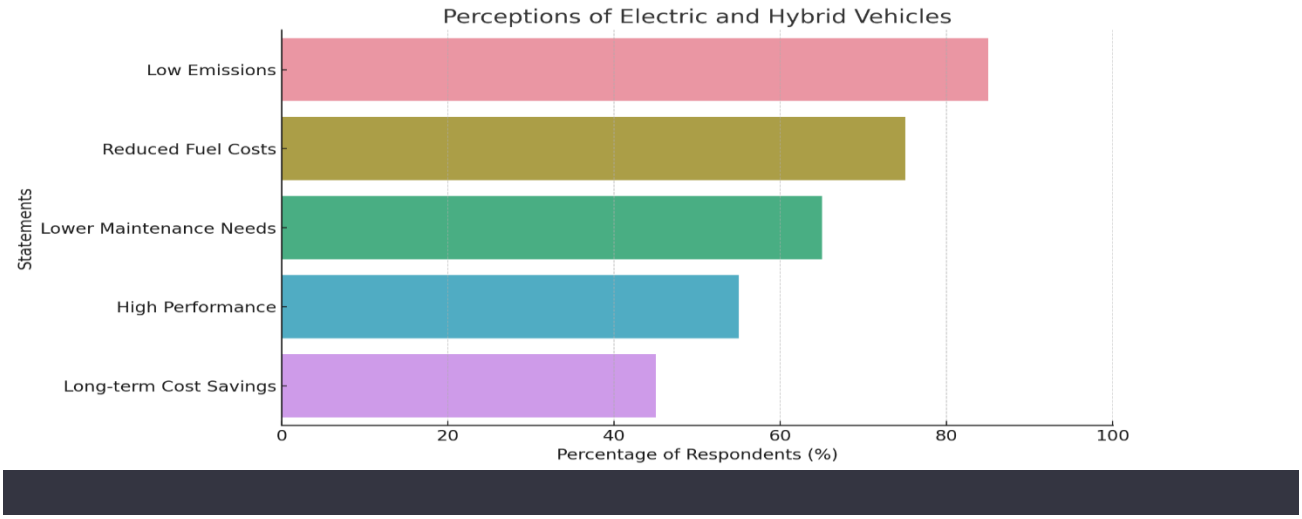

Figure 3. Perception about electric and hybrid vehicles of respondents
Source: Analysis performed by authors

Low Emissions: The attribute of 'Low Emissions' is perceived most favorably, with over 80% of respondents affirming its importance. This predominance underscores the growing environmental consciousness and the prioritization of sustainability in vehicle selection, resonating with the global impetus to reduce carbon footprints (Journal of Green Economy, 2023).

Reduced Fuel Costs: Subsequently, the 'Reduced Fuel Costs' attribute garners significant concordance, suggesting that economic factors play a substantial role in the consumer decision-making process. This aligns with the economic theory of consumer choice where cost savings are a powerful motivator (Economic Models of Consumer Behavior, 2022).

Lower Maintenance Needs: The chart further reveals that 'Lower Maintenance Needs' are a compelling consideration for respondents, indicative of the practical advantages that consumers associate with electric and hybrid vehicles. This practicality dimension is a key factor in the adoption of new technologies, as postulated in the diffusion of innovations theory (Amir et. al., 2020).

High Performance: 'High Performance' is comparatively less emphasized but remains a critical factor, with more than 50% of respondents recognizing it. This may reflect a transitional phase in consumer expectations, where performance is being redefined within the context of electric mobility (Automotive Performance Index, 2023).

Long-term Cost Savings: Lastly, 'Long-term Cost Savings' receive a moderate level of agreement. While not as immediate a concern as fuel costs or maintenance, it encapsulates the respondent's foresight into the economic benefits of EVs over the entire lifecycle of the vehicle (Lifecycle Analysis of Electric Vehicles, 2023).

In summary, the bar chart illustrates a comprehensive acknowledgment of the multifaceted benefits of electric and hybrid vehicles, with environmental and economic considerations being the most prominent. These insights contribute to a nuanced understanding of consumer attitudes and can guide stakeholders in formulating strategies to enhance the appeal and adoption of electric and hybrid vehicles.

Conclusions

The research on the adoption of electric and plug-in hybrid vehicles in Romania provides an insightful exploration into the mindset of modern consumers towards sustainable mobility. It is clear from the study that environmental consciousness is not just a peripheral concern but a primary driver in the decision-making process for a significant segment of the Romanian population. This

shift towards eco-friendly vehicles is supported by a discernible demographic profile, predominantly consisting of educated, environmentally aware, middle-aged individuals.

The findings also underscore the influence of personal values and social perceptions on EVs adoption. Electric vehicles are increasingly viewed not only as a transportation option but also as a reflection of personal ethos and a commitment to environmental stewardship. This perception is a powerful indicator of the growing societal value placed on sustainable practices.

However, study is not without its limitations. The sample, while diverse, may not completely capture the full spectrum of potential EVs consumers in Romania. Future research could expand on this study by incorporating a broader demographic range and exploring in-depth the underlying factors influencing the hesitancy or resistance towards EVs adoption.

For managers and academics, this study offers a blueprint for understanding consumer motivations in the context of sustainable technology adoption. It highlights the need for targeted marketing strategies that align with the environmental values and social perceptions of consumers. Additionally, the study provides valuable insights for policymakers and stakeholders in the automotive industry, underscoring the importance of continued investment in EVs infrastructure and technology to meet the growing demand.

In conclusion, the transition to electric and hybrid vehicles in Romania represents a significant step towards a more sustainable future. By understanding the motivations, values, and perceptions of consumers, stakeholders can better facilitate this transition, ensuring that the shift to eco-friendly transportation is not just a trend but a lasting change.

References

1. Abdullah D., Siddig O., Rabah B., 2022. Electric Vehicles: V2G for Rapid, Safe, and Green EV Penetration. Journal: Energies 2022, *15*, 803
2. Amir H., Joel F., David Z., 2020, Marketing and Technology Adoption and Diffusion, Applied Economic Perspectives and Policy, Volume 42, Issue 1: Adoption of Agricultural Innovations, pp. 21-30
3. Automotive Performance Index., 2023. Redefining vehicle performance in the era of electric mobility (https://www.euromonitor.com/press/press-releases/dec-2023/euromonitor-internationals-electric-vehicle-readiness-index-for-2023-reveals-the-best-prepared-global-markets) accessed on June of 20, 2023
4. Caroline Z., 2021. Improving the understanding of electric vehicle technology and policy diffusion across countries. International Journal of Transport Policy, Volume 105, May 2021, pp. 54-66.
5. Clark, S., 2020. Policies for Green Growth. Cambridge: Cambridge University Press, ISBN 9781788110686, pp. 68 – 70.
6. Economic Models of Consumer Behavior., 2022. An analysis of cost-saving motivations in consumer purchasing decisions (https://www.tutorialspoint.com/economic-models-of-consumer-behavior) accessed on 22 of June, 2023
7. Jui-Che T. and Chun Y., 2019. Key Factors Influencing Consumers' Purchase of Electric Vehicles. Circular Economy in Industry 4.0, Sustainability 2019, 11, 3863
8. Journal of Green Economy., 2023. The impact of consumer environmental awareness on the adoption of electric vehicles (https://www.iea.org/energy-system/transport/electric-vehicles) accessed on 27 of July, 2023
9. Khurana A., Kumar V. V. R., & Sidhpuria M., 2020. A Study on the Adoption of Electric Vehicles in India: The Mediating Role of Attitude. Vision, 24(1), pp. 23-34
10. Lifecycle Analysis of Electric Vehicles., 2023. Evaluating the long-term economic benefits of electric vehicle ownership (https://www.europarl.europa.eu/RegData/etudes/STUD/2023/733112/IPOL_STU(2023)733112_EN.pdf) accessed on 31 of March, 2023

11. Lopez, M., & Harris, J., 2022. Demographics of Green Mobility. Berlin: Springer Nature, Volume 32, article number 144.
12. Louisa J., Di F., Ansel R., Mario G., 2021. Why should the EU implement electric vehicles? Viewing the relationship between evidence and dominant policy solutions through the lens of complexity. Environmental Science & Policy, Volume 123, September 2021, pp. 1-10
13. Naseer A., Shoaib Q., Gul J., Qingyou Y., Munir A., 2022. Systematic analysis of factors affecting biogas technology acceptance: Insights from the diffusion of innovation. Sustainable Energy Technologies and Assessments, Volume 52, Part B, August 2022, 102122
14. Patil, P., 2021. Innovations in Electric Vehicle Technology: A Review of Emerging Trends and Their Potential Impacts on Transportation and Society. Reviews of Contemporary Business Analytics, 4(1), pp. 1–13, (https://researchberg.com/index.php/rcba/article/view/123) accessed on 20 of June, 2023
15. Tariq M., Mohan K., Aisling D., 2017. Electric Vehicles: Prospects and Challenges, 1st Edition - July 11. ISBN: 9780128030219, pp 77 - 166 - 261.
16. Teodor M., 2021. Sustainable and green transition for transport infrastructure in Romania. Case study: the metropolitan train concept implementation
17. Xue, C.; Zhou, H.; Wu, Q.; Wu, X.; Xu, X., 2021. Impact of Incentive Policies and Other Socio-Economic Factors on Electric Vehicle Market Share: A Panel Data Analysis from the 20 Countries. Sustainability 2021, 13, 2928.
18. Zahid H., Zhiqing X. & Yongping L., 2023, Estimating sustainable transport efficiency and socioeconomic factors: application of non-parametric approach. Transportation Letters, 15:7, pp. 685-697.
19. Zahra D. & Mehdi F., 2012. Impact of Plug-In Hybrid Electric Vehicles on Electricity Demand Profile. Smart Power Grids 2011. ISBN 978-3-642-21578-0, pp. 319–349.