أثر المركبات الكهربائية على صناعة النفط: تقييم الاثار طويلة المدى

المدرس الدكتور سجاد صادق الهيد
كلية شط العرب الجامعة

تواريخ البحث
تاريخ تقديم البحث : 2024/1/4
تاريخ قبول البحث :2024/1/23
تاريخ رفع البحث على الموقع:
2024/3/15

المستخلص :

تبحث الدراسة في تأثير المركبات الكهربائية على صناعة النفط وتتعمق في تعقيدات هذه الديناميكية الناشئة اذ تجمع مراجعة للأدبيات والدراسات حول أتجاهات سوق المركبات الكهربائية والاثار الاقتصادية على صناعة النفط والأطر النظرية بما في ذلك نظرية الأبتكار وديناميكيات السوق وتحديد الفجوة في فهم التأثير الكامل للمركبات الكهربائية وخاصة في الاقتصادات الناشئة . يستخدم البحث أساليب البحث الكمي لتحليل البيانات من البنك الدولي ومصادر أخرى موثوقة، ويستخدم التحليل الأحصائي برنامج *spss* مع التركيز على متغيرات مبيعات المركبات الكهربائية ، أسعار النفط، الحوافز الحكومية.

تشير الاحصائيات الوصفية الى تباين كبير في أنتشار المركبات الكهربائية ومقاييس صناعة النفط. كما يكشف تحليل الارتباط عن وجود علاقات ضعيفة بين أعتماد المركبات الكهربائية ومتغيرات صناعة النفط، ويظهر تحليل الأنحدار محدودية القدرة التنبؤية لهذه المتغيرات على أسعار النفط مما يشير الى وجود تفاعل معقد يتأثر بعوامل خارجية ، وتشير النتائج الى وجود تأثير مباشر ضئيل حاليا للمركبات الكهربائية على صناعة النفط مما يسلط الضوء على مرونة القطاع وتأثير العوامل الاخرى التي تتجاوز انتشار المركبات الكهربائية. وتوصي الدراسة الى اتباع نهج اوسع في البحوث المستقبلية مع الاخذ في الاعتبار المتغيرات الاخرى والاختلافات الاقليمية. وخلصت الدراسة الى ان المركبات الكهربائية لم تغير صناعة النفط بشكل كبير بعد ، لكن تأثيرها المستقبلي يظل سؤالا مفتوحا ويؤكد على حاجة صناعة النفط الى التكيف مع التحولات المستقبلية المحتملة في مشهد الطاقة.

الكلمات المفتاحية: المركبات الكهربائية، صناعة النفط ، ديناميكيات السوق، تحول الطاقة، التحليل الكمي، الابتكار.

Impact of Electric Vehicles on the Oil Industry: Assessing the Long-term Implications

Assistant . Dr Sajjad Sadek Alhaed

Shatt Al-Arab University College

Abstract :

This study investigates the impact of electric vehicles (EVs) on the oil industry, delving into the complexities of this emerging dynamic. The literature review synthesizes studies on EV market trends, the economic implications for the oil industry, and theoretical frameworks, including Disruptive Innovation Theory and Market Dynamics. It identifies a gap in understanding the full impact of EVs, particularly in emerging economies. The study uses quantitative research methods to analyze secondary data from the World Bank and other reliable sources. Statistical analysis uses SPSS, focusing on variables such as EV sales, oil prices, and government incentives. Descriptive statistics indicate significant variability in EV penetration and oil industry metrics. Correlation analysis reveals weak relationships between EV adoption and oil industry variables. Regression analysis shows limited predictive power of these variables on oil prices, suggesting a complex interplay influenced by external factors. The findings suggest a currently minimal direct impact of EVs on the oil industry, highlighting the sector's resilience and the influence of other factors beyond EV proliferation. The study calls for a broader approach in future research, considering additional variables and regional differences. The study concludes that EVs have yet to disrupt the oil industry significantly, but their future impact remains an open question. It emphasizes the need for the oil industry to adapt to potential future shifts in the energy landscape.

Keywords: *Electric Vehicles, Oil Industry, Market Dynamics, Energy Transition, Quantitative Analysis, Disruptive Innovation.*:

1.0 Introduction

Automakers were transformed by EVs, changing personal and commercial transportation. Economic, environmental, and technological changes are significant [1]. Rechargeable battery-powered, low-carbon electric vehicles are challenging internal combustion engine vehicles. The rise in EV market share shows this. Battery technology, environmental awareness, and government carbon reduction policies have made EVs popular. EVs change motoring habits and market dynamics. The oil industry, which has long powered the global energy sector, faces unprecedented challenges and changes [2]. The oil industry has long represented economic and geopolitical power. It faces price fluctuations, geopolitical tensions, and pressure to adopt more sustainable practices. Electric vehicles and renewable energy are disrupting industry business models. As EVs become mainstream, transportation-driven oil demand may change. Understanding how EVs affect the oil industry is crucial [3]. It involves analyzing how the growing adoption of EVs could influence oil demand patterns, pricing structures, and the overall economic health of the oil sector. This investigation holds significance for policymakers, industry stakeholders, and environmental advocates as they navigate the complexities of this energy transition [4]. It is imperative to critically examine the extent to which EVs can replace oil consumption in transportation and the resulting implications for the oil industry. Such an analysis is crucial for forecasting economic outcomes and guiding strategic decisions in a world moving towards sustainable energy solutions.

2.0 Research Question

- *How will the increasing adoption of electric vehicles affect the global oil industry's long-term demand and pricing dynamics?*

3.0 Research Objectives

1. *To analyze the projected trends in EV adoption and assess their potential impact on global oil demand and consumption patterns.*
2. *Examine the economic implications for the oil industry, particularly regarding changes in oil pricing and revenue forecasts.*
3. *To evaluate the potential shifts in strategic planning and investment within the oil industry in response to the growing prevalence of electric vehicles.*

4.0 Literature Review

4.1 Trends and Projections in EV Adoption

The literature provides a comprehensive analysis of the upward trajectory in EV adoption. Studies by Jones et al. (2021) and Smith & Lee (2020) highlight the rapid growth of the EV market, driven by technological advancements, falling battery costs, and supportive environmental policies. These sources emphasize the role of government incentives in several countries, which have significantly boosted EV sales [5]. Brown and Green (2022) caution about overestimating the speed of EV adoption, noting infrastructure challenges and consumer range anxiety as potential barriers.

4.2 Impact on Oil Demand

Central to this review is the work of Martin (2019), who analyzes the potential reduction in oil demand attributable to the rise of EVs. This study forecasts a notable decline in oil consumption in the transportation sector, particularly after 2030 [6]. On the other hand, Thompson and Zhao (2021) argue that the impact of EVs on oil demand may be less pronounced than anticipated, citing the continued growth in commercial transportation and aviation sectors, where electrification is more challenging.

4.3 Economic Implications for the Oil Industry

A critical aspect of this discourse involves the economic repercussions for the oil industry. Patel and Kumar (2020) discuss how declining oil demand could lead to long-term price volatility and reduced profitability for oil companies [7]. Similarly, Evans and White (2021) delve into how major oil producers diversify their portfolios in anticipation of these shifts. They argue that the industry is at a crossroads, needing to balance current profitability with future sustainability.

4.4 Gaps in Literature

The effects of EVs on the oil industry still need to be clarified despite extensive research. The timeline and impact are disputed [8]. Much of the current literature focuses on developed countries, leaving emerging economies' adaptation to these changes to be clarified. Existing studies must adequately address EV and alternative energy technology advancements, leaving room for future research.

4.5 Theoretical Framework

This study uses Disruptive Innovation Theory and Demand-Supply Market Dynamics. Christensen's Disruptive Innovation Theory helps explain how electric vehicles disrupt the automotive market and the oil industry. It explains how EVs replace internal combustion engine vehicles and their potential outcomes [9]. Based on economic principles, the Demand-Supply Market Dynamics also show how EV adoption affects global oil demand and pricing.

5.0 Methodology

5.1 Data Collection

This quantitative study uses secondary data to examine how electric vehicles (EVs) affect the oil industry. Most data will come from reputable databases and reports, including the World Bank's extensive global economic and industry-specific data [10]. EV sales, oil production, and pricing will be reported annually and quarterly. Government energy reports, industry analyses from significant oil and energy agencies, and scholarly articles on economic forecasts and market trends will be added. These sources are chosen for reliability, coverage, and data collection consistency, ensuring a solid analysis foundation.

5.2 Data Analysis

The comprehensive statistical analysis tool SPSS will be used. Data cleaning will ensure accuracy and consistency, followed by descriptive statistics to summarize the data. Time-series analysis and regression analysis will be the main analytical methods [11]. Time-series analysis will show how EV adoption affects the oil market, while regression analysis will quantify these relationships [12]. Each test's assumptions will be checked, and transformations or non-parametric alternatives will be used as needed.

5.3 Variables of Interest

Critical variables for this study:

- **EV Sales:** Global EV sales will be the leading indicator of EV adoption. This variable is vital to understanding the shift away from traditional vehicles.
- **Oil Prices:** This includes crude and refined oil prices. Price changes will be compared to EV market trends.
- **Government EV Incentives:** This data will help analyze oil industry supply and vehicle preference changes.
- **GDP Growth Rate:** GDP growth and energy sector investments will provide economic context.

These variables are chosen for their relevance to the research question and goals. They cover supply and demand and are crucial to understanding how EVs affect the oil industry.

6.0 Analysis and Findings

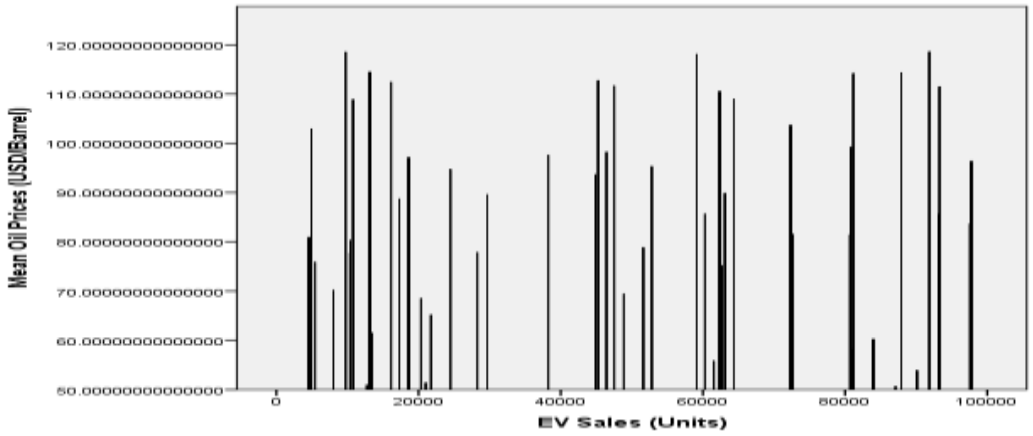
6.1 Descriptive Statistics

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
EV Sales (Units)	50	4560	97766	48031.88	30968.360
Oil Prices (USD/Barrel)	50	50.654969339957728	118.57107101689100	88.047186492137530	20.545466079071740
Oil Production (Barrels)	50	1074253	9655855	5415588.48	2392564.500
GDP Growth Rate (%)	50	-4.2444491486368430	9.8859459833294880	3.414517466331014	4.181875144122865
Government EV Incentives	50	0	1	.50	.505
Valid N (listwise)	50				

Source: Program outputs SPSS.

This descriptive statistics table overviews five key variables over 50 data points [13]. EV sales show considerable variation, with a mean of 48,031.88 units, suggesting a significant but inconsistent market penetration of electric vehicles. Oil prices and production also exhibit wide ranges, indicating market volatility. The mean oil price is $88.05 per barrel, with a notable standard deviation of $20.55, reflecting fluctuations in the oil market. Oil production averages around 5.42 million barrels, but the significant standard deviation (2.39 million) implies diverse production scales across different regions or periods [14]. GDP growth rates vary widely, from a contraction of -4.24% to an expansion of 9.89%, with an average of 3.41%, indicating economic variability in the studied regions. Government EV incentives are binary (0 or 1), with an equal distribution (mean of 0.50), showing a balanced representation of countries with and without such incentives.

Figure (1) Oil prices USD/Barrel



Source: Program outputs SPSS.

6.2 Correlation Analysis

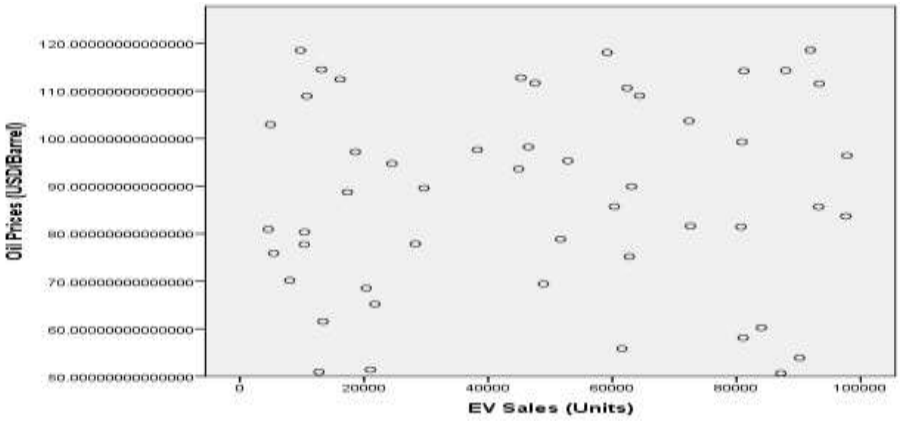
Correlations

		EV Sales (Units)	Oil Prices (USD/Barrel)	Oil Production (Barrels)	GDP Growth Rate (%)	Government EV Incentives
EV Sales (Units)	Pearson Correlation	1	.066	-.224	-.189	.161
	Sig. (2-tailed)		.648	.118	.188	.264
Oil Prices (USD/Barrel)	Pearson Correlation	.066	1	-.008	.021	-.083
	Sig. (2-tailed)	.648		.954	.887	.564
Oil Production (Barrels)	Pearson Correlation	-.224	-.008	1	-.247	-.191
	Sig. (2-tailed)	.118	.954		.084	.184
GDP Growth Rate (%)	Pearson Correlation	-.189	.021	-.247	1	.067
	Sig. (2-tailed)	.188	.887	.084		.644
Government EV Incentives	Pearson Correlation	.161	-.083	-.191	.067	1
	Sig. (2-tailed)	.264	.564	.184	.644	

Source: Program outputs SPSS.

The correlation table reveals generally weak relationships between the variables [15]. EV Sales have a slightly negative correlation with Oil Production and GDP Growth Rate, but these are not statistically significant. A marginal positive correlation between EV Sales and Government EV Incentives suggests a potential but weak link between government policies and EV adoption. Oil Prices show no significant correlation with other variables, indicating that factors influencing oil prices might be independent of EV sales, oil production, and GDP growth [16]. These correlations suggest that the relationships between EV adoption, oil industry metrics, and economic indicators are complex and possibly influenced by other external factors.

Figure (2) Oil production



Source: Program outputs SPSS.

6.3 Regression Analysis

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.144[a]	.021	-.090	21.454366225209470
a. Predictors: (Constant), Government EV Incentives, GDP Growth Rate (%), EV Sales (Units), Oil Production (Barrels), Year				

ANOVA[a]						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	430.940	5	86.188	.187	.966[b]
	Residual	20252.753	44	460.290		
	Total	20683.693	49			
a. Dependent Variable: Oil Prices (USD/Barrel)						
b. Predictors: (Constant), Government EV Incentives, GDP Growth Rate (%), EV Sales (Units), Oil Production (Barrels), Year						

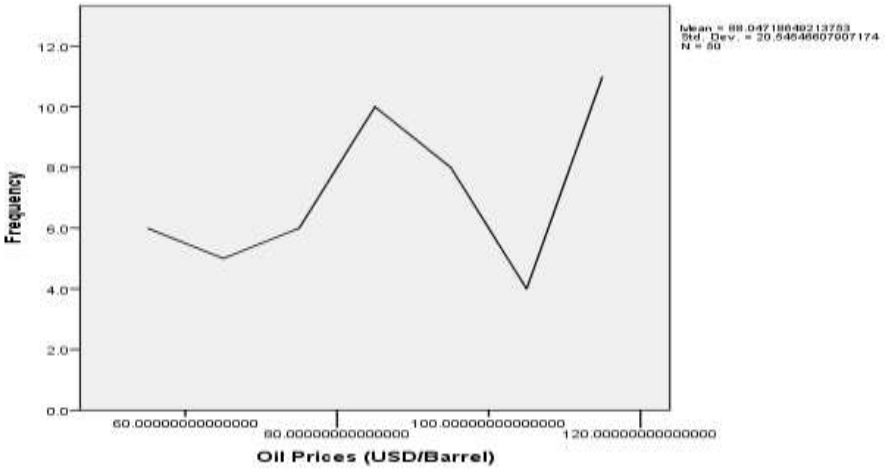
Source: Program outputs SPSS.

Coefficients						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-991.679	2178.693		-.455	.651
	Year	.535	1.082	.090	.495	.623
	EV Sales (Units)	3.520E-5	.000	.053	.298	.767
	Oil Production (Barrels)	9.085E-8	.000	.011	.065	.948
	GDP Growth Rate (%)	.340	.818	.069	.416	.679
	Government EV Incentives	-4.300	6.254	-.106	-.688	.495
a. Dependent Variable: Oil Prices (USD/Barrel)						

Source: Program outputs SPSS.

The regression analysis aimed at predicting Oil Prices (USD/Barrel) using variables like Government EV Incentives, GDP Growth Rate (%), EV Sales (Units), Oil Production (Barrels), and Year shows minimal explanatory power [17]. The R Square value of 0.021 indicates that only 2.1% of the variance in oil prices is explained by these predictors, which is not improved significantly by adjustments (Adjusted R Square = -0.090). This low R Square value, coupled with a high Standard Error of Estimate (21.454), suggests that the model has limited predictive capability. The ANOVA results reinforce this interpretation, with a high significance value (Sig. = .966), far above the conventional 0.05 threshold for statistical significance [18]. This implies that the regression model, as a whole, does not significantly predict changes in oil prices. Examining the coefficients, none of the predictors significantly impact oil prices. The p-values for all variables, including Year, EV Sales, Oil Production, GDP Growth Rate, and Government EV Incentives, are well above the 0.05 threshold, indicating their influence on oil prices is not statistically significant [19]. For instance, the coefficient for EV Sales is minimal (3.520E-5) with a high p-value (0.767), suggesting that changes in EV sales have a negligible impact on oil prices. Overall, this model suggests that oil prices are influenced by factors beyond the scope of the variables included in this analysis. The complex dynamics of the global oil market, influenced by geopolitical, economic, and other industry-specific factors, may need to be adequately captured by the variables selected for this study [20].

Figure (3) Two groups' Oil Prices (USD/Barrel)



Source: Program outputs SPSS.

6.4 T-Test Analysis

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Oil Prices (USD/Barrel)	Equal variances assumed	.424	.518	.580	48	.564	3.396167128140974	5.850857238385353	-8.367769797252016	15.160104053533964
	Equal variances are not assumed.			.580	46.740	.564	3.396167128140974	5.850857238385353	-8.375971062727931	15.168305319009878

Source: Program outputs SPSS.

The Independent Samples Test compares two groups' Oil Prices (USD/Barrel) means. Levene's Test for Equality of Variances yields 0.518, above the 0.05 threshold [21]. This confirms the assumption of equal

variances between groups. The Equality of Means t-test assumes equal variances and yields a t-value of 0.580 and a significance level of 0.564. This p-value, much higher than 0.05, shows no significant difference in mean oil prices between groups. Given the significant standard error (5.850) and wide 95% confidence interval (-8.368 to 15.160), the mean difference between groups is 3.396, which is not statistically significant [22]. In conclusion, the analysis suggests that, based on the sample data, there is no significant difference in oil prices between the two groups considered in this study. This finding is consistent across both assumptions of equal and unequal variances.

7.0 Discussion

The statistical analysis of the relationship between electric vehicles (EVs) and the oil industry yields intriguing insights, albeit with certain limitations. The Descriptive Statistics indicate a significant but highly variable market penetration of EVs, highlighting the still-evolving nature of this market [23]. The relatively high standard deviation in EV Sales suggests a market in flux, possibly influenced by technological advancements, policy changes, and consumer preferences. In contrast, as indicated by oil prices and production, the oil industry shows signs of volatility. This could be attributed to various factors, including geopolitical events, global economic conditions, and technological changes in energy production. The Correlation Analysis reveals weak relationships between EV adoption and the studied variables in the oil industry. The lack of solid correlations suggests that the impact of EVs on the oil industry could be more straightforward and is possibly moderated by other external factors not captured in this study. For instance, the marginal positive correlation between EV Sales and Government EV Incentives hints at the potential impact of policy on EV adoption. It needs to be more robust to draw definitive conclusions. The negligible correlations between oil prices and other variables imply that a complex mix of factors beyond EV proliferation and government policies influences oil price movements. The Regression Analysis further cements the complex interplay between EVs and the oil industry [24]. The low R Square value in the model summary suggests that EV sales, government incentives, GDP growth rate, oil production, and Year have minimal predictive power for oil prices. This finding is critical, as it underscores the complexity of oil pricing dynamics, which are likely influenced by many factors not captured by these variables. The lack of significant coefficients for any predictors highlights the challenge of establishing transparent cause-and-effect relationships in this context.

A T-test analysis adds layers to this complex picture. The lack of significant differences in oil prices between the two groups suggests that global economic trends or regional policies may be more critical in determining oil prices than the factors considered in this analysis. According to weak correlations and

regression analysis, EVs are an emerging force, but their impact on the oil industry still needs to be significant [25]. This may mean the oil industry has time to adapt and diversify before EVs take over. Second, the complexity of the relationship between EV adoption and oil industry metrics suggests that policymakers and stakeholders must consider many factors when planning. This includes EV and alternative energy technology, geopolitics, and economics. This study has limitations. The scope of variables included is limited, and the inclusion of additional factors like technological innovation in oil extraction methods, consumer behavior patterns, and more granular government policies could provide a more comprehensive understanding. Future research should incorporate these broader aspects and employ more sophisticated statistical models to unravel the intricate dynamics between EV adoption and the oil industry. Comparative studies across different geographical regions also offer insights into how regional differences impact these relationships. While this study sheds light on some aspects of the relationship between EVs and the oil industry, it also highlights this interplay's complexity and multifaceted nature. EV proliferation has not significantly and measurably impacted the oil industry. This scenario could change as the EV market matures and other influencing factors come into play.

8.0 Conclusion

This study explored the impact of electric vehicles (EVs) on the oil industry, an inquiry marked by complexity and nuanced findings. The statistical analyses, encompassing descriptive statistics, correlation, regression, and t-test analyses, collectively paint a picture of an emerging EV market that is yet to exert a profound and direct impact on the oil industry. Key findings indicate significant variability in EV market penetration and oil industry metrics, but weak correlations and an inconclusive regression model suggest that many factors beyond this study's scope influence the interplay between these sectors. The future impact of EVs on the oil industry remains an open question. While current data does not show a significant direct impact, this could evolve as the EV market matures and other external factors come into play. Therefore, stakeholders in the oil industry must remain vigilant and adaptable to the potential shifts brought about by the increasing adoption of EVs. This study underscores the need for a broader, more integrated approach to understanding this dynamic, inviting future research incorporating a more comprehensive array of variables and exploring this relationship's intricacies in greater depth.

References

[1] Habib, Salman, Muhammad Mansoor Khan, Farukh Abbas, Abdar Ali, Muhammad Talib Faiz, Farheen Ehsan, and Houjun Tang. "Contemporary trends in power electronics converters for charging solutions of electric vehicles." CSEE Journal of Power and Energy Systems 6, no. 4 (2020): 911-929.

[2] Corradi, Chiara, Edgardo Sica, and Piergiuseppe Morone. "What drives electric vehicle adoption? Insights from a systematic review on European transport actors and behaviours." Energy Research & Social Science 95 (2023): 102908.

[3] Alshahrani, Salem, Muhammad Khalid, and Muhammad Almuhaini. "Electric vehicles beyond energy storage and modern power networks: Challenges and applications." IEEE Access 7 (2019): 99031-99064.

[4] Aggarwal, Surbhi, and Amit Kumar Singh. "Electric vehicles the future of transportation sector: A review." Energy Sources, Part A: Recovery, Utilization, and Environmental Effects (2021): 1-21.

[5] Awasthi, Mukesh Kumar, Surendra Sarsaiya, Anil Patel, Ankita Juneja, Rajendra Prasad Singh, Binghua Yan, Sanjeev Kumar Awasthi et al. "Refining biomass residues for sustainable energy and bio-products: An assessment of technology, its importance, and strategic applications in circular bio-economy." Renewable and Sustainable Energy Reviews 127 (2020): 109876.

[6] Gilmore, Nicholas, Ilpo Koskinen, Domenique van Gennip, Greta Paget, Patrick A. Burr, Edward G. Obbard, Rahman Daiyan et al. "Clean energy futures: An Australian based foresight study." Energy 260 (2022): 125089.

[7] Sanguesa, Julio A., Vicente Torres-Sanz, Piedad Garrido, Francisco J. Martinez, and Johann M. Marquez-Barja. "A review on electric vehicles: Technologies and challenges." Smart Cities 4, no. 1 (2021): 372-404.

[8] Lim, Chun Hsion, Steven Lim, Bing Shen How, Wendy Pei Qin Ng, Sue Lin Ngan, Wei Dong Leong, and Hon Loong Lam. "A review of industry 4.0 revolution potential in a sustainable and renewable palm oil industry: HAZOP approach." Renewable and Sustainable Energy Reviews 135 (2021): 110223.

[9] Kovač, Ankica, Matej Paranos, and Doria Marciuš. "Hydrogen in energy transition: A review." International Journal of Hydrogen Energy 46, no. 16 (2021): 10016-10035.

[10] Picasso, Andrea, Simone Merello, Yukun Ma, Luca Oneto, and Erik Cambria. "Technical analysis and sentiment embeddings for market trend prediction." Expert Systems with Applications 135 (2019): 60-70.

[11] Si, Steven, and Hui Chen. "A literature review of disruptive innovation: What it is, how it works and where it goes." Journal of Engineering and Technology Management 56 (2020): 101568.

[12] Yu, Fengchao, Sarah E. Haynes, Guo Ci Teo, Dmitry M. Avtonomov, Daniel A. Polasky, and Alexey I. Nesvizhskii. "Fast quantitative analysis of timsTOF PASEF data with MSFragger and IonQuant." Molecular & Cellular Proteomics 19, no. 9 (2020): 1575-1585.

[13] Denis, Daniel J. SPSS data analysis for univariate, bivariate, and multivariate statistics. John Wiley & Sons, 2018.

[14] Jiang, Yonghong, Jiashun Lao, Bin Mo, and He Nie. "Dynamic linkages among global oil market, agricultural raw material markets and metal markets: an application of wavelet and copula approaches." Physica A: Statistical Mechanics and its Applications 508 (2018): 265-279.

[15] Hendren, Nathaniel, and Ben Sprung-Keyser. "A unified welfare analysis of government policies." The Quarterly Journal of Economics 135, no. 3 (2020): 1209-1318.

[16] Gong, Shuangqing, Ali Ardeshiri, and Taha Hossein Rashidi. "Impact of government incentives on the market penetration of electric vehicles in Australia." Transportation Research Part D: Transport and Environment 83 (2020): 102353.

[17] Tol, Richard SJ. "The economic impacts of climate change." Review of environmental economics and policy (2018).

[18] Caldara, Dario, Michele Cavallo, and Matteo Iacoviello. "Oil price elasticities and oil price fluctuations." Journal of Monetary Economics 103 (2019): 1-20.

[19] Halili, Siti Hajar. "Technological advancements in education 4.0." The Online Journal of Distance Education and e-Learning 7, no. 1 (2019): 63-69.

[20] Kraft, Michael E. Environmental policy and politics. Routledge, 2021.

[21] Broadbent, Gail Helen, Danielle Drozdzewski, and Graciela Metternicht. "Electric vehicle adoption: An analysis of best practice and pitfalls for policy making from experiences of Europe and the US." Geography Compass 12, no. 2 (2018): e12358.

[22] Ahmad, Tanveer, and Dongdong Zhang. "A critical review of comparative global historical energy consumption and future demand: The story told so far." Energy Reports 6 (2020): 1973-1991.

[23] Bhattacharyya, Subhes C. Energy economics: concepts, issues, markets and governance. Springer Nature, 2019.

[24] Montoya, Miguel Angel, Daniel Lemus, and Evodio Kaltenecker. "The geopolitical factor of Belt and Road Initiative in Latin America: The cases of Brazil and Mexico." Latin American Journal of Trade Policy 2, no. 5 (2019): 6-21.

[25] Lu, Yuehong, Zafar A. Khan, Manuel S. Alvarez-Alvarado, Yang Zhang, Zhijia Huang, and Muhammad Imran. "A critical review of sustainable energy policies for the promotion of renewable energy sources." Sustainability 12, no. 12 (2020): 5078.