

Clean Energy and New Energy Vehicle in Uncertain Situation

Ziqing Xiao *

International Business School of Suzhou, Xi'an Jiaotong-liverpool University, Suzhou, 215127, China

* Corresponding Author Email: Ziqing.Xiao20@student.xjtlu.edu.cn

Abstract. According to recent research, only a few about how the Russia-Ukraine conflict infects the WTI market, also how the influence affects green energy vehicles and the clean energy market. This paper aims to use the VAR model and ARMA-GARCH model to analyze the impact on clean energy and green energy vehicles by examining the changes in stock returns and the volatility of these two industries after they were subjected to changes in WTI stock price caused by the Russia-Ukraine conflict. Through analysis finds that in the short-term because of the western development countries restrain, the WTI export in Russia is difficult, the world WTI price will grow dramatically, and more people choose clean energy vehicles as an alternative, which result in an increase in clean energy and green energy vehicles' stock price increase, but in the long run, these three industries' stock price will return to their original level. In response to this situation, clean energy vehicle enterprise should innovate their technology and protect their users' safety, which makes their customers more rely on their products.

Keywords: Russia-Ukraine Conflict; Clean Energy; Green Energy Vehicles;

1. Introduction

More governments now urge citizens to adopt green energy as a result of global warming and growing environmental preservation consciousness. Petroleum and coal cannot be entirely substituted, though, as people are more accustomed to using conventional cars. Russia is the second-largest exporter of crude oil in the world, and in recent years, its economy has demonstrated its reliance on natural resources. Multiple rounds of economic sanctions have been imposed on Russia by western nations since 2012, with the United States serving as its undisputed leader. These sanctions, particularly the ban on oil exports, have hampered Russia's economic recovery. The main issue affecting Russia's energy exports will be oversupply after the conflict between Russia and Ukraine began on February 24, 2022, and after the U.S. and other western nations progressively slapped new rounds of sanctions on Russia in the future. The conflict between Russia and Ukraine is what started the international energy crisis and had a significant and lasting effect on how the world developed its energy industry. The battle has brought to light the drawbacks of the global energy system based on fossil fuels and will hasten the rebuilding of the global energy pattern. Additionally, this will hasten the transition to clean energy and low-carbon sources, as well as encourage the clean replacement of energy consumption and production.

How will WTI, green energy cars, and green energy development change in the future? International crude oil prices are continuing to rise sharply as the war situation becomes more serious. People are choosing green energy vehicles due to rising oil prices, which encourages the quick growth of green energy. The U.S. and Europe are moving faster toward energy independence, and there is growing support for carbon peaking and carbon neutrality. The global energy transition's energy trend is the development of a clean, safe, low-carbon, contemporary energy system. Someone else, however, also believed that the geopolitical dangers and undeveloped technologies for the widespread use of new energy exacerbate the issue of energy security and serve as the primary impediment to the global expansion of clean energy.

While the Russia-Ukraine conflict had some impact on the WTI, green energy vehicles and clean energy, it may not be sustainable. Through the existing literature and related data, this article expects that the conflict will have some impact on three industries in a short period, but due to the adjustment

and response of the financial market, the stock prices volatility brought about by the conflict will still not cause long-term fluctuations to these three industries.

The remaining part of this paper is organized as follows: Part 2 is the literature review, which includes relevant research on the development of green energy vehicles and clean energy in recent years and how the conflict has brought about a change in three industries' stock prices, concluding with a summary of the literature review. Then it is followed by Part 3, which uses certain data and images as an aid and focuses on the impact of the conflict dispute on these three industries. After that, the fourth section will use four different methods to analyze the relevant data obtained. The results of the empirical analysis were used to demonstrate results of the impact of the Russia-Ukraine conflict and the future prediction of three industries' stock price trends. Then, the paper will give some recommendations to investors and decision-makers on how to understand and use the results of the paper. Finally, making a short conclusion on the basic research findings.

2. Literature Review

2.1. The development Trend of Clean Energy and Green Energy Vehicles

As Yang stated, with the promotion of the high-tech revolution, the world economy keeps growing at a high speed and people's living standards keep improving. As a result, the energy crisis and environmental problems brought by modern means of transportation such as cars are also increasing [1]. However, Cong considered that the environmental problem is not the only driver of electric cars. Green energy vehicles will eventually replace fuel vehicles and refine the automobile industry, which is rooted in technological progress, consumption concept upgrading and industrial ecological remodeling [2].

Since the 1970s oil crisis, the U.S., Japan and other developing countries for a long time the integrated use of legal, economic, financial and other means to encourage green energy technology research and development, production and consumption, forming the roadmap to fully support the development of green energy, accumulated lots of experience, and establish their comparative advantages in the field of green energy. However, Zheng and Xu argued that in China and some developing countries, the development of green energy is still facing problems such as lack of core technology and surplus production capacity at the low-end [3]. As Yang and Chen stated that since 2012, China has become the world's largest energy consumer, its energy investments have been the largest for many consecutive years, and China is leading the world in green energy development [4]. Also, in America, the Obama administration has launched an economic recovery plan that combines short-term policies, one in eight in direct investments in clean energy and tax breaks to encourage its development could be called America's green energy strategy [5].

2.2. The influence of three industries by the Russia-Ukraine conflict

As the second biggest oil exporter, the conflict first influences the crude oil export quantity, and because less petroleum is available which causes global petroleum prices to increase. To reduce the spending on oil, more consumers are considered to purchase green energy vehicles without gas. As Wei et al. stated that the crude oil market and the global green economy have a positive interaction effect on the whole, but there are heterogeneous changes in different regions, and the situation in Asia is especially complex. Also, the two-way dynamic circulation transmission mechanism of the "crude oil price-demand-green economy" has been formed between the crude oil market and the global green economy, and the reverse transmission has a deeper effect and is more stable than the forward transmission [6]. As Mao stated, because of the less supply of crude oil from Russia and Dual control of carbon emissions China had control the total fossil energy using, the government encourage citizens using clean energy [7].

The pattern of international oil trade has undergone profound adjustment, with major changes in the flow of crude oil trade and intensified competition for similar resources. The pricing power and voice of exporting countries have been significantly enhanced, while the costs of importing countries

have been significantly increased. According to Wang et al. consideration, they think China as the largest importer of crude oil around the world, should improve the rotation mechanism of strategic petroleum reserves and try to carry out market operations; People will accelerate the development of renewable energy and promote the green and low-carbon transformation of the oil industry [8].

2.3. review of the literature

Overall, the research on the development history and future trend of green energy and clean energy vehicles has been relatively well reached, but the impact of the Russia-Ukraine conflict brought to WTI is rarely, also contained only a little research about how the WTI influence clean energy vehicles and green energy. It is difficult to predict the future development of the world's green energy industry. Therefore, this paper hopes to do more to fill the gaps in the research in this area and use empirical data to demonstrate the impact of the conflict on the current and long-term development of the world's WTI, clean energy vehicles and green energy markets.

3. Research Design

3.1. Data source

This paper uses a search engine, the Choice financial terminal, to search and collect data on closing stock prices on clean energy, green energy vehicle and WTI, from six months before the Russia-Ukraine conflict till the present. Emphasizing the stock price fluctuations of three industries before and after the conflict erupted, as the source and basis for empirical analysis to study the impact of the conflict between Russia and Ukraine on WTI, green energy vehicles and green energy.

3.2. ADF test

After completing the model construction, first set a model which performs a unit root test, and let the original hypothesis is the model is not smooth. After putting the data into Stata and performing the ADF test, as Table 1 shows that the p-value for the long-returns is 0, the result can reject the original hypothesis and determine the model is stable and feasible.

Table 1. ADF test.

Variables	t-statistic	p-value
Price		
Clean energy	-1.311	0.8851
New energy vehicle	-3.646	0.0262**
WTI	-1.565	0.8057
Yield		
Clean energy	-10.995	0.0000***
New energy vehicle	-8.975	0.0000***
WTI	-11.603	0.0000***

3.3. VAR model identification

$$X_t = \sum_{i=1}^p \prod_i X_{t-i} + U_t \quad (1)$$

$$LR = -2(\text{Log}L_k - \text{Log}L_{k+1}) \quad (2)$$

$$AIC = \log \left[\frac{\sum_{t=1}^T e_t^2}{T} \right] + \frac{2k}{T} \quad (3)$$

From equation (1) above, the author can figure out the necessary and sufficient conditions of stationary of the VAR model. Also, as Figure 1 shows below, all the points are inside the circle. Therefore, the VAR model is stable. LR model and AIC model (equations 2 and 3) are both used to determine the maximum lag. According to Xue and Li, the VAR model are more accurate [9].

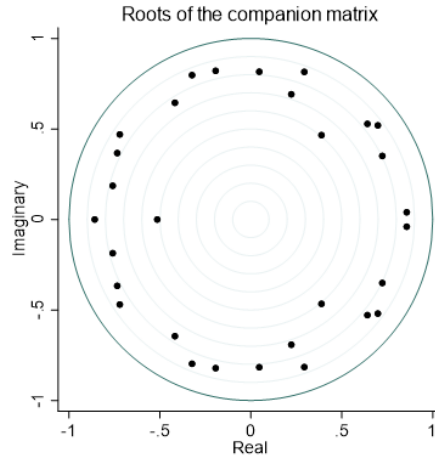


Figure 1. Unit circle test.

3.4. ARMA-GARCH model identification

3.4.1 Model specification: ARMA

$$x_t = \phi_0 + \sum_{i=1}^p \phi_i x_{t-i} + \alpha_i - \sum_{i=1}^q \phi_i a_{t-i} \quad (4)$$

From equation (4) above, $\phi_0 + \sum_{i=1}^p \phi_i x_{t-i}$ represents the AR(p) model, which uses the historical returns of the stocks to predict the future; while $\alpha_i - \sum_{i=1}^q \phi_i a_{t-i}$ which uses past volatility to estimate the future and the last part of the model. In this paper, the AR model uses the past historical returns, while the MA model uses an error term to forecast the future.

3.4.2 Model specification: ARMA-GARCH-X

After that, this paper constructs ARMA-GARCH models of the returns and volatilities of the stocks of WTI, clean energy and green energy vehicles. This paper uses the time point of the Russian-Ukraine conflict erupt as dummy variables and adds them to the mode for calculation. As a result, this paper can assess the correlation between the conflict and the return and volatilities of the stocks of three industries.

The model GARCH (p, q) is set as follows:

$$\alpha_t^2 = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \cdots + \alpha_q \varepsilon_{t-q}^2 + \gamma_1 \sigma_{t-1}^2 + \cdots + \gamma_p \sigma_{t-p}^2 + \beta_1 WTI \quad (5)$$

In equation (5) above, the term $\alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \cdots + \alpha_q \varepsilon_{t-q}^2$ is the ARCH part, σ_t^2 is the conditional variance of the disturbance term ε_t , and the subscript t indicates that variance changes over time. σ_t^2 Depends on the square of the disturbance term in the previous p periods. And the last part of the model $\beta_1 * Crude Oil_t$ represents the Log rate of return of crude oil. GARCH model is set up based on the ARCH model, with the addition of autoregression of σ_t^2 . In equation (5), the term $\gamma_1 \sigma_{t-1}^2 + \cdots + \gamma_p \sigma_{t-p}^2$ is the GARCH part.

4. Empirical Results and Analysis

4.1. VAR Estimation Results

As Table 2 shows, the result of LR is 10, which is the maximum likelihood of the lag, while using the AIC method, the result is equal to 0, which should be rejected.

Specifically, in the paper, the VAR model uses the historical returns of three industries over the past six months before the conflict erupted to the present and the pulse effect of crude oil price changes on the returns of new energy vehicles and clean energy industries is investigated.

Table 2. VAR model identification.

Lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	1570.97				1.5e-10*	-14.1259*	-14.1073*	-14.0799*
1	1579.15	16.35	9	0.060	1.5e-10	-14.1184	-14.0442	-13.9345
2	1583.02	7.7412	9	0.560	1.6e-10	-14.0722	-13.9423	-13.7503
3	1591.17	16.31	9	0.061	1.6e-10	-14.0646	-13.879	-13.6048
4	1592.65	2.953	9	0.966	1.7e-10	-13.9968	-13.7555	-13.3991
5	1595.7	6.1113	9	0.729	1.8e-10	-13.9433	-13.6462	-13.2076
6	1604.21	17.005	9	0.049	1.8e-10	-13.9388	-13.5861	-13.0651
7	1609.87	11.332	9	0.254	1.8e-10	-13.9088	-13.5003	-12.8972
8	1612.11	4.4692	9	0.878	1.9e-10	-13.8478	-13.3837	-12.6983
9	1615.84	7.4763	9	0.588	2.0e-10	-13.8004	-13.2806	-12.5129
10	1628.72	25.752*	9	0.002	2.0e-10	-13.8353	-13.2598	-12.4099
11	1636.39	15.347	9	0.082	2.0e-10	-13.8234	-13.1922	-12.26
12	1643.61	14.44	9	0.108	2.0e-10	-13.8073	-13.1204	-12.106

4.2. Pulsating Response

Starting from the fundamentals, in the short period after the outbreak of the Russia-Ukraine conflict, along with the sharp rise in oil price, the stock market of the whole financial market in China fluctuated violently in a short period and went down rapidly. However, as time went by, each stock index recovered to the level before the conflict this situation shows that the Russia-Ukraine conflict is more of a short-term shock to the whole financial market. In the medium and long term, the financial market reflects its fundamentals more than short-term shocks.

In terms of the energy industry, as a substitute for traditional energy, the rise in oil price will almost certainly lead to an increase in the consumption of clean energy, but it is necessary to build a model to quantify this impact.

As far as the auto industry is concerned, the increase in the price of oil is a huge negative for the traditional fuel car industry. As an alternative to traditional fuel vehicles, changes in oil prices have little impact on consumer vehicle costs.

As a substitute for fuel vehicles, intuitively speaking, green energy vehicles seem to benefit from the oil price shock, but in fact, the impact of rising oil prices on new energy vehicle enterprises has two completely different effects:

First, the increase in crude oil price will certainly increase the car cost of consumers, so from the perspective of substitutes, the increase in oil price will indeed increase the sales of new energy vehicles. Second, as the blood of the modern manufacturing industry, oil plays a crucial role in production the manufacture of complete vehicles involves various sub-industries of the manufacturing industry. The increase in oil prices will lead to an increase in production costs in these industries. If according to the basic economic assumption, enterprises cannot adjust the price in the short term, the increase in production cost must mean a decrease in revenue. Then, the impact of oil price increase on new energy vehicles depends on whether the positive effect brought by sales growth is greater than the negative effect brought by cost increase.

From the impulse response diagram, as Figure 2 shows, the oil price shock of 1 unit in period $t=0$ will cause the return rate of the above two industries to fluctuate around the value of 0 in the future, but it is difficult to judge the positive and negative effects.

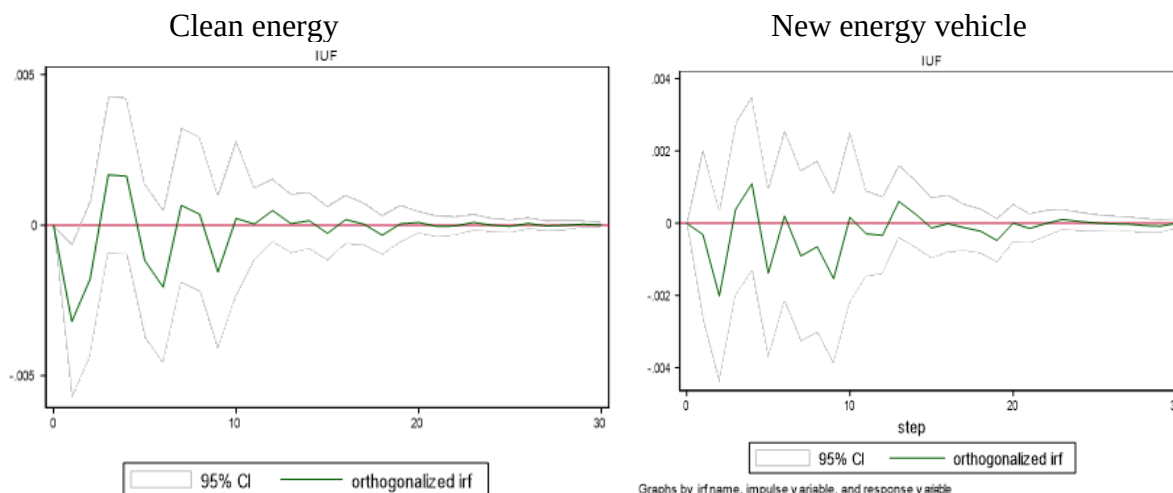


Figure 2. Impulse and response.

Obviously, from the estimation results of the cumulative response function, as Figure 2 shows, the cumulative impact of the current oil price shock on the return rate of the clean energy industry in the next 30 periods is about 6%, and the impact on the return rate of the green energy vehicle industry is about 2%.

The value also shows that, due to the cost-effectiveness, higher oil prices have less impact on the green energy vehicles industry.

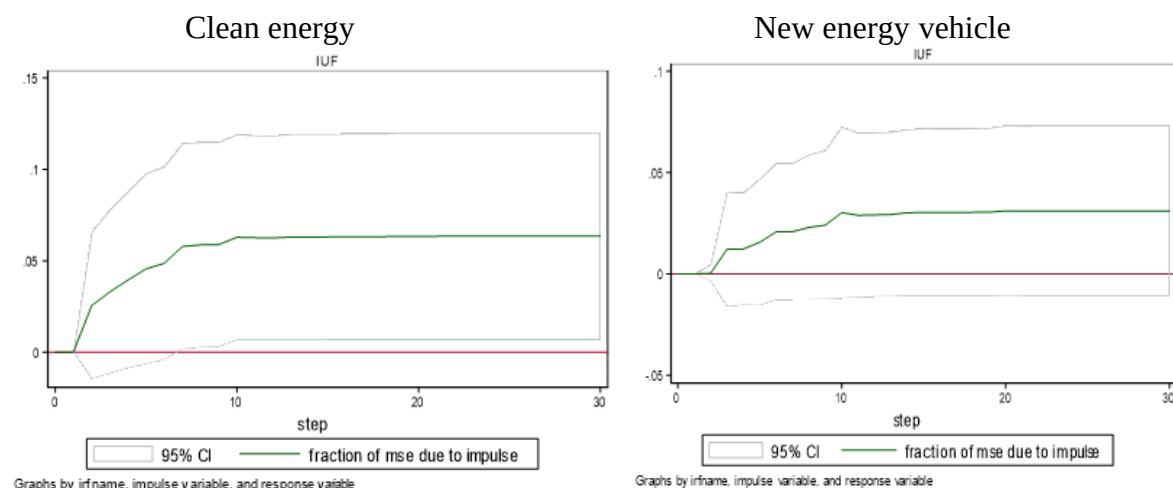


Figure 3. Cumulative response.

4.3. ARMA-GARCH estimate result

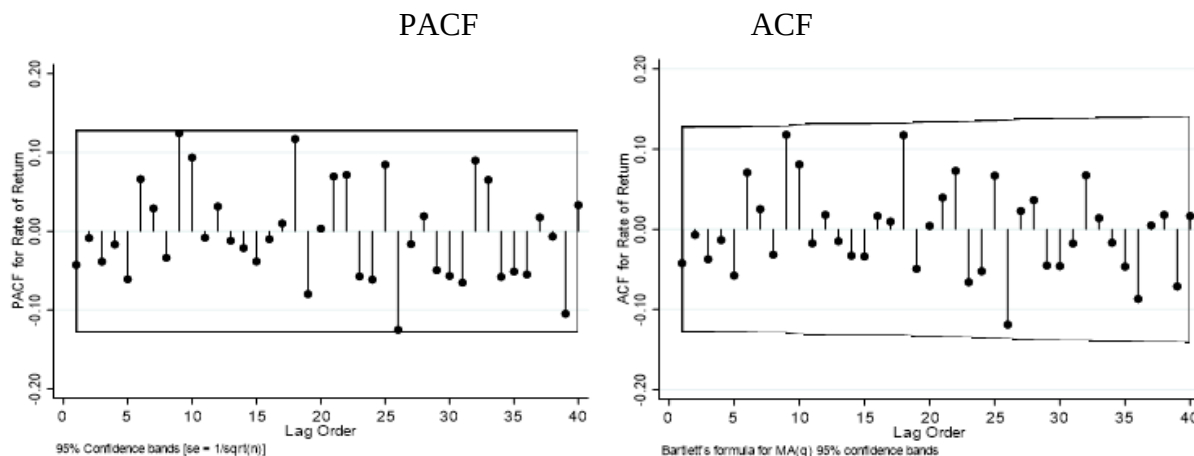


Figure 4. PACF and ACF, clean energy.

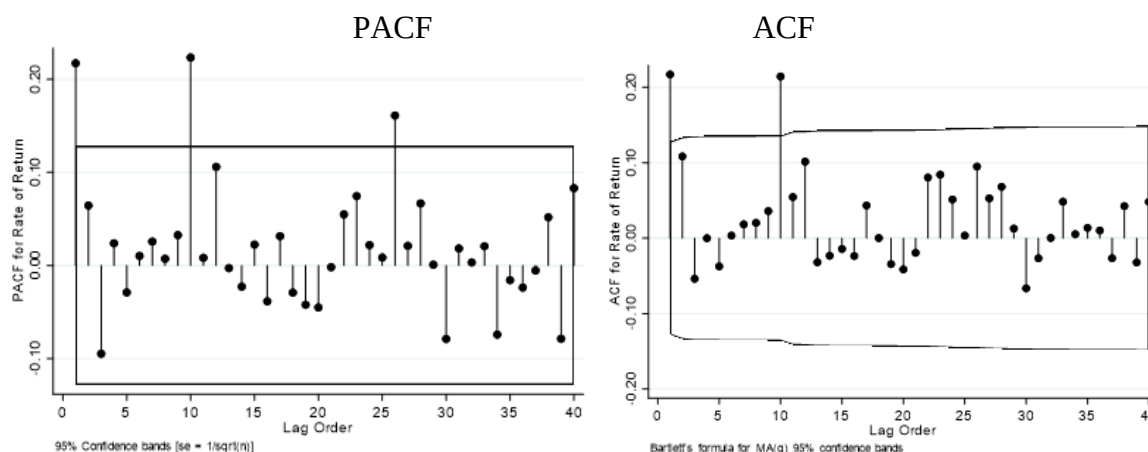


Figure 5. PACF and ACF, new energy vehicle.

Using the PACF and ACF method, Figure 3 shows that all the lag order are in the scope, thus, the lag result of green energy is not existed, using the same method, the author can get that the result of clean energy vehicles is one, which shows on the Figure 4. According to the estimation results of ARMA-GARCHX, as Table 3 shows, the ARCH effect and GARCH effect of the model in column (1) is not significant, which is not suitable for using the conditional heteroscedastic model. The ARCH effect is significant in the model in column (2), indicating that the return rate of the new energy vehicle industry has statistically significant conditional heteroscedastic property. However, judging from the estimation results of external explanatory variables, oil price does not affect its daily volatility. Accordingly, this paper speculates that the impact of oil price on the above two industries occurs slowly.

Table 3. ARMA-GARCHX estimation results.

Variables	(1)			(2)		
	Clean power			New energy vehicle		
	Coefficient	Std. err	p> Z	Coefficient	Std. err	p> Z
AR, L9				-0.9173	0.1972	0.000
MA, L9				0.8960	0.2345	0.000
Constant	0.0000	0.0013	0.989	0.0014	0.0012	0.241
WTI	-1.4535	2.5263	0.565	4.3284	6.1501	0.482
ARCH, L1	-0.0672	0.0431	0.119	0.4182	0.0937	0.000
GARCH, L1	-0.4989	0.4434	0.260	0.2091	0.1434	0.145
Constant	-7.2604	0.2870	0.000	-8.6832	0.3103	0.000

5. Discussion

This paper shows similar results to Huang, which stated that crude oil price increases will boost green energy vehicles and clean energy development [10]. However, this essay considers that the cost of green energy vehicles' technology upgrades and the cost increase caused by the aggrandizing of demand, may hinder the development of green energy vehicles.

The article mainly uses the VAR model and ARMA-GARCH model to analyze and integrate the relevant and represent the impact on green energy vehicles and clean energy by examining the changes in stock returns and the volatility of these two industries after they were subjected to changes in WTI stock price caused by Russia-Ukraine conflict, and concludes that the green energy vehicles and the clean energy industry will be affected by Russia-Ukraine in the short term, while this impact is not significant enough in the long term to have a significant impact on the future development of these two industries.

Looking ahead, the government can still do a lot to pursue the development of green energy vehicles and clean energy. Firstly, the government can adopt macro-control to prevent oil prices from rising continuously. Secondly, if the government supports environmental protection, it can give

partial subsidies to the new energy vehicle industry to reduce the cost pressure on enterprises. Also, raising the price of coal and other fuels encourages operators to choose clean energy alternatives. Considering it from the other side, the WTI price will keep increasing in the short term because Russia continues constrained by western developing countries such as United State. At the same time, clean energy and green energy vehicles' price will not change hugely.

6. Conclusion

The object of this paper is to study how the clean energy and green energy vehicles around the world have been affected and impacted in the short and long term respectively by the WTI price change caused by the Russia-Ukraine conflict and to predict and make recommendations on the future direction and development of the green energy vehicles and clean energy industries. In short term total financial market swing wildly and decrease sharply. But in the long term, the shock market will restore to the original level.

At a time when the world is more connected and emerging technologies are refining society, if the green energy vehicles want to develop wildly, the enterprises should be more proactive in improving their competitiveness, relying on superior technological innovation and product safety to respond to a series of restrictive measure against Russian crude oil. It is also necessary to actively seek cooperation and seek to complement the resource and technologies of other countries in the field of green energy vehicles and clean energy, to seek better development in the future.

References

- [1] G. Yang, 2013. Current situation and development prospect of new energy vehicles under global warming environment [J]. Power Supply Technologies and Applications, 2013 (9): 386-386.
- [2] X. Cong, 2021. The global development of new energy vehicles has entered a fast lane. Financial View, 2021 (5): 18-19
- [3] Y. Zheng, L. XU, 2012. The Process of Developing Green Energy in Developed Countries and Its Lessons. Resources Science, 2012, 34(10): 1855-1863
- [4] Z. Yang, Z. Chen, 2022. Protect Green Energy Resources and Enhance Green and Low-carbon Awareness [J]. Tianjin Science & Technology, 2022, 49(7): 124-126
- [5] Z. Li, 2010. Green New Deal for Sustainable Development - Countries are vigorously developing green energy. ANHUI SCIENCE & TECHNOLOGY, 2010 (5): 52-53
- [6] Y. Wei, et al., 2022. The interactions between crude oil market and development of global green economy. Systems Engineering —Theory & Practice, 2022, 42 (7): 1843-1858
- [7] X. Mao, 2022. Consider the reform direction of carbon market and green electricity consumption mechanism from the perspective of total carbon emission control [J]. Yuejiang Academic Journal, 2022, 14(4): 75-77
- [8] P. Wang, et al., 2022. New characteristics of global oil market and new trends of oil trade under high oil prices [J]. International Petroleum Economics, 2022, 30(6): 35-44
- [9] L. Xue, S. Li, 2022. Research on accuracy test method of VaR model [J]. Model World, 2022, (6): 7-9
- [10] Z. Huang, 2020, The Influence of international crude oil futures price fluctuation on earnings persistence of new energy listed companies in China: An intermediary effect based on the stock price of new energy companies [D]. Xi'an University of Technology, 2020